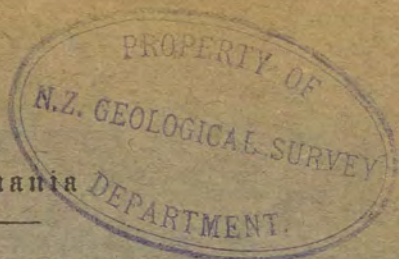


TWELVETREES



Tasmania

DEPARTMENT OF MINES

GEOLOGICAL SURVEY BULLETIN

No. 25

The Gladstone Mineral District

BY

W. H. TWELVETREES, Government Geologist

Issued under the authority of

The Honourable Sir NEIL ELLIOTT LEWIS, K.C.M.G.,
Minister for Mines for Tasmania



Tasmania:

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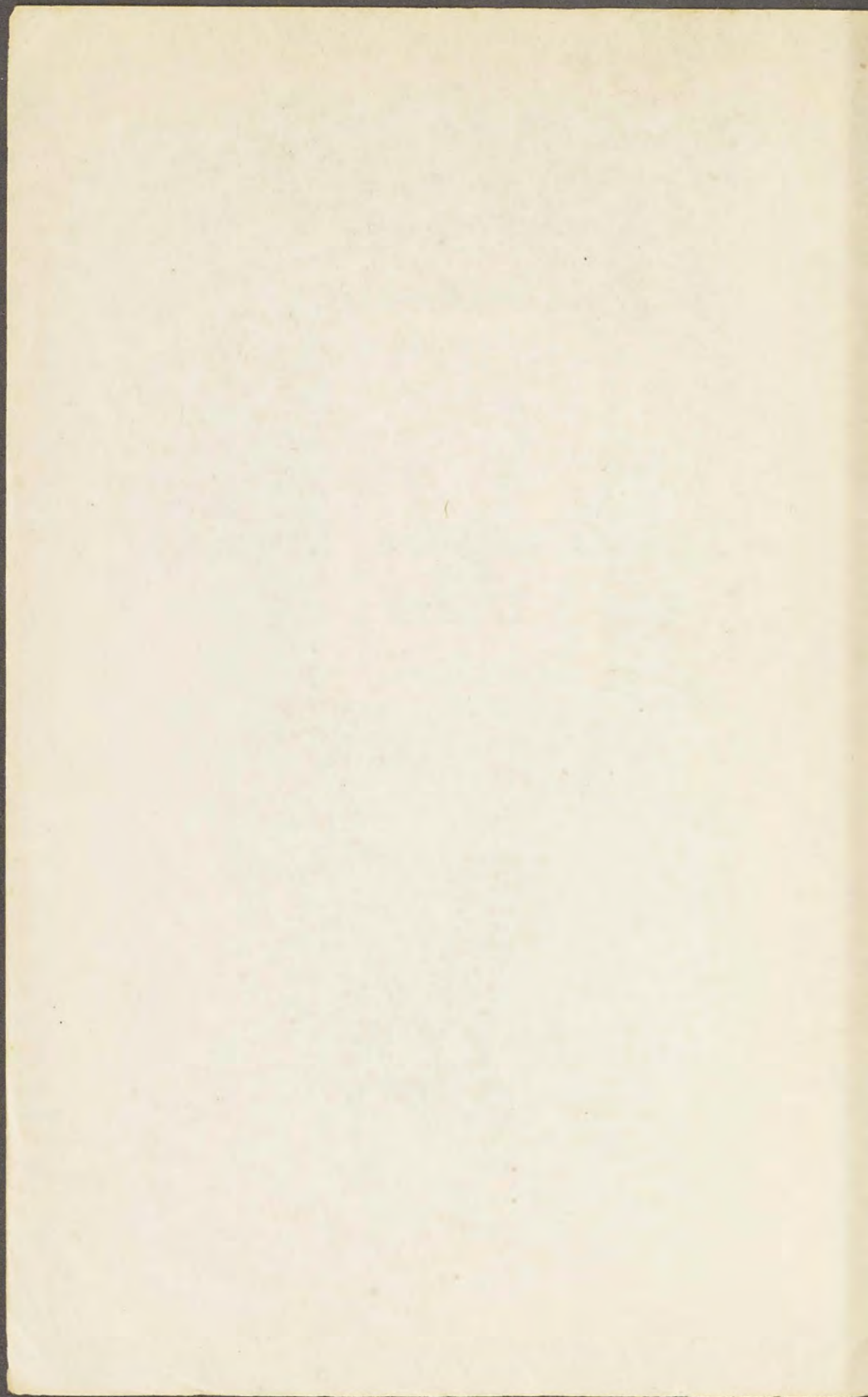


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The Gladstone Mineral District.

I.—INTRODUCTION

THE present bulletin embodies the description of a field journey in the Gladstone mineral district. The township of Gladstone is in the north-east corner of the island, 13 miles south of Bass Straits, at Lyme Regis, and 9 miles south-east of the port of Boobyalla, in Ringarooma Bay. A good road connects with the port. Between Boobyalla and Launceston ketches ply with cargo at not infrequent intervals. Gladstone is at the terminus of the postal motor service, which connects it with the Government railway at Branhholm, through Moorina and Derby. It is 27 miles from Branhholm.

Gently undulating country to the north, and extending to the sea, is held by a few families under grazing leases, and a little farming is also successfully carried on. Owing to its geographical position, the district is exposed to strong gales, but numerous sheltered localities exist, where the soft rotten slate soil would no doubt be favourable to the culture of fruit. Gladstone, however, has a fame of its own as the centre of a persistent tin-mining industry. For over 40 years the alluvial mines have supported an industrious, self-contained community, and even now, though nearly half its population of working miners has drifted away to the theatre of war, a modest output of over 90 tons per annum is being steadily maintained.

The tin ore is for the most part concentrated in gravels and drifts, which cover the surrounding country. The mineral is found from the grass roots downwards to 50, or even 100, feet from the surface, and is largely won by hydraulicking. For continuous mining operations the intermittent supplies of water from streams in the vicinity of the various claims are inadequate, and are supplemented by the admirably-managed service of a Government race, which distributes water over a large area of the field, and is an inestimable boon to the industry.

Although the quantities of alluvial tin ore are so considerable, no tin lodes of any importance have been discovered. Fragments of tin-bearing vein quartz are occasionally met with in the mine workings, and some greisen dykes or lodes carrying tin ore are known. On the other hand, greisenised marginal portions of granite masses are fairly rich in the ore. From such belts of rock and from veinlets in the granite, and perhaps also from disseminations in it, the greater part of the alluvial tin has probably been derived.

II.—GENERAL GEOLOGY.

Cambro-Ordovician.—The oldest strata exposed in this district are the slates and sandstones lying to the north of the granite area occupied by Mt. Cameron and the country generally south of the Ringarooma. They are locally indurated and affected by the granitic intrusion. They strike, as a rule, either north and south, or a few degrees west of north, and are essentially part of the body of similar strata which, interrupted by the Mt. Cameron and Blue Tier granite masses, extend southwards from George's River. Their geological age has been tentatively postulated as Ordovician, though no graptolites or other fossils which would determine the correctness of this reference have been met with. The beds were unquestionably deposited at some time between the close of the Pre-Cambrian and the beginning of the Silurian proper, and thus fall in a general way into what in Tasmanian stratigraphy is provisionally termed the Cambro-Ordovician.

Devonian.—The granite rock forms the Mt. Cameron massif, rising into rough, wooded peaks, 1800 feet above the level of the sea. The timber on its northern flanks is lighter, and much more open than on the southern slopes of the mountain, doubtless owing principally to its position with reference to the sea. A fine view of the surrounding country is obtained from some of the peaks at the summit of the range. The mountain mass rises out of the low country all round it, which, with its covering drifts to the north, slopes gradually to the coast. The view assists one in realising vividly how recently the sea laved the foot of the range.

The rock has intruded into the slate and sandstone series along an east and west line at the northern foot of Mt. Cameron, bending north-east on the Fly-by-Night section, whence the line of junction crosses the main road south of Gladstone to the river a few hundred feet north of the Esk dam, and proceeds on the east bank of the Ringarooma northwards to a few chains south of the new bridge. South of the Ringarooma granite country, covered largely with drift, rises in a southerly direction towards the Blue Tier.

The granite is the normal biotite-granite variety (petrographically granitite), with a fair amount of plagioclase feldspar, in addition to the orthoclase mineral. Its ten-

dency is to be porphyritic, and occasionally it is pegmatitic, and, in fact, it takes on all the variations of structure and texture commonly met with in large masses of granite. Where its margins are strongly stanniferous, as at the Fly-by-Night and Harden's Ravine, the rock is converted into typical greisen.

Mesozoic Diabase.—The Gondwanaland deposits, which at one time overlaid a large area of the granite rock, have been completely denuded in this neighbourhood. Some remnants of them are still noticeable on the summit of the Blue Tier, but the Mt. Cameron peaks show no survivals. The intrusive diabase rock, which was irrupted at the close of the Mesozoic era, is seen forming the low Ringarooma Tier east of Boobyalla, and forming headlands on the Cape Portland coast. It emerges north of the Prince Imperial Mine, east of T. Groves' 30 acres lot W of the Mussel Roe, also on John Foster's 640-acre lots north of Gladstone, and again in the granite along the Government race on the Upper Great Mussel Roe. The rock has no connection whatever with any of the mineral deposits of the region.

Tertiary and Quaternary.—Over the bedrock of a large portion of the district there is a widespread accumulation of late Tertiary drifts and gravels, varying from a few feet to at least 100 feet in thickness, and ranging in age down to the Recent, or Human, period. Some of the Tertiary beds are firmly consolidated as conglomerates and grits. Fragmentary sections of river leads are found buried beneath marine and beach deposits, but obliterated for great distances, owing to subsequent movements of the land.

The aboriginal Tasmanian race, having wandered southward into Tasmania before it became an island, were eye-witnesses of the breaking down of all land connection with Australia, and of the accumulation of the drifts by the action of the sea right up to the base of Mt. Cameron, and over the Edina and Amber Creek country; and they saw also the subsequent recession of the sea and the emergence of the land from beneath the waters, the islands in the strait remaining as the highest points of the former land bridge. The aboriginal chipped flake found recently at the Doone Mine denotes the existence of the Tasmanian race here prior to the deposition of the marine drift covering, and consequently also prior to the formation by the Ringarooma River of its present channel.

III.—ECONOMIC GEOLOGY.

The ore-deposits in the district under consideration belong to two classes, namely—(1) primary deposits, or such as have resulted from either igneous emanations or precipitation from aqueo-igneous solutions; and (2) secondary deposits, or such as have been formed by the natural disintegration of mineral-bearing rocks and veins. The first division comprises ores in veins, dykes, stockworks, or rock-masses; in the second are included the alluvial deposits.

The ores of the primary deposits are assumed to have a direct connection with rocks consolidated from igneous magmas; in the case of the Gladstone areas, with the granite. The tin and tungsten are considered to have been extracted by high temperature aqueous vapours from the granitic magma during its consolidation, and to have been deposited in fissures or other cavities in the cooling granite or in the stratified rocks immediately adjacent to it. The ores of these metals therefore, are pneumatolytic; that is, derived from the igneous magma through the agency of dissolved gases. At a greater distance from the granite conditions were cooler, and metals such as lead and zinc were deposited from the magmatic solutions, which took the place of igneous vapours.

The gold found in such lodes as the Portland, Blue Bell, Prince Imperial, &c., has been deposited by a different process from that which obtained in the essentially high temperature reefs of the Royal Standard and Royal Tasman mines. It has been precipitated from solutions, together with the pyritic, blende, and galena minerals of those lodes, whereas the gold in reefs last mentioned (associated with tin) belonged to the class of metals conveyed by dissolved gases, arriving in the fissures at the same time as the tin and tungsten.

The gold which is so frequently met with in intimate association with the tin ore won from the alluvial deposits in this part of the State (Derby, Gladstone, Mt. Cameron, &c.) is pneumatolytic gold for the most part, and accordingly its deposition was effected under different conditions from those of the quartz reefs of Mt. Victoria and Mathinna.

While the depth of the granite below the surface probably increases considerably in a northerly direction across

the Ringarooma, its underground surface-plane at the Fly-by-Night and on the Royal Tasman and Mint properties is no doubt shallower, and it is quite possible that it might be struck in deep shafts below the level of the creek. In such case the reefs in the granite would probably be found to carry tin ore as the dominant mineral. The writer is informed by Mr. Chaffey that the tin mineral was detected in the deeper parts even of the Royal Tasman workings. Fleming's tin and wolfram reef is displaced a little at its intersection by the Royal Standard reef, which might lead to a hasty conclusion that the tin and wolfram antedate the gold on the field; but from the fact that tin and gold are associated in other reefs in the vicinity it may be inferred that the occurrence referred to is only local, and does not affect the larger question. From what can be observed, it seems clear that the appearance of tin ore in the gold-quartz reefs of this part of the field need not be altogether unexpected.

The gold of the Royal Tasman field, as is usual in Tasmania when in close proximity to granite (though there are exceptions), is accompanied by a considerable proportion of silver. The Royal Tasman gold was worth only £3 9s. per oz. Individual assays, however, are very irregular in this respect. Assays of samples from Fleming's reef in the new shaft have given as much as 4 oz. silver to 10 oz. gold, and as little as 1 oz. silver to 8 oz. gold, per ton.

Some veins or dykes of greisen issuing from the granite mass have penetrated the adjacent slates and sandstones, and carry a little tin ore. It is possible that in point of time their formation was a little prior to that of the neighbouring gold-quartz reefs. There is also an appearance now and then of copper sulphide in the gold quartz reefs. It may be seen on the tip of a shaft south of Fleming's new make, and here and there in minute quantity in the quartz in Fleming's shaft. This mineral here may also be regarded as having been deposited under pneumatolytic conditions.

At the Fly-by-Night and in Harden's Ravine there is within the boundary of the granite rock an extensive development of greisen. In this modification of granite the felspar and quartz have been replaced by mica quartz topaz, tin ore, &c., during the pneumatolytic process, forming a special type of rock of special value as a matrix of tin ore. This, at the Fly-by-Night, forms a broad bor-

der or marginal part of the granite, and is of economic importance. The ore may be expected to be more abundant in the immediate vicinity of the granite-slate contact, and to fade away gradually as the distance from the contact is increased. That the metallic contents of the rock will fall off within any reasonable depth from surface is not to be anticipated, for it is easy to show that the present surface represents a purely accidental horizon in the column of ore-deposition.

Mt. Cameron has undoubtedly shed large quantities of tin ore into the drifts and alluvial basins of the surrounding country, though prospecting on the mount itself has so far revealed but few tin veins or solid formations. The latter fact has given rise to the belief that the tin mineral exists largely as grains in the solid unaltered granite. While this may be the case to some extent, it is probable that (apart from greisen formations) the ore has been released from narrow veinlets in the granite. At the same time, blocks of quartz several inches thick have been found in alluvial workings thickly studded with tin ore, so evidently some of these veins are of a fair size.

Mt. Cameron, however, has not been the sole source of tin ore in the district. Quantities of mineral won over wide areas of granite country south of Gladstone make it highly probable that the bulk has been derived from the gradual wearing down of the extensive granite surface. The casual, but widespread, distribution of the ore by the agency of the sea legitimately encourages the belief that the work done on the field has far from exhausted the deposits.

The Ringarooma River in this region flows in a comparatively modern channel. Below Branhholm it originally flowed out to sea somewhere west of Mt. Cameron, and it was only subsequently that it meandered through the country south of the mount, and found its way towards Bass Strait *via* the Great Northern Plain. Flowing over a granite bottom between Derby and Gladstone it has accumulated at several points in its course quantities of tin ore. Its waters have also sluiced some of the ore contained in the ancient drifts which they traverse, and reconcentrated them here and there. Some of these concentrations have been worked by dredging, not always, however, with success. The large quantities of stones of sandstone and slate in the present bed of the river and in the shingle deposits near its banks, which mark its

former course, can be explained only by assuming that the drifts and stones were brought by the sea from the north.

Granite rock reappears on the lower Mussel Roe about 3 miles from its mouth. Its mica mineral is muscovite or white mica, which is a good indication here of tin ore. It also carries sporadic tourmaline, and near its contact with the slate a little wolfram in small nests and veins of quartz. The country to the east of this does not seem to have been adequately prospected, and no definite information about it could be obtained, but all the granite area here warrants examination.

As regards wolfram, the only reef in the district in which it has been found in what can be called appreciable quantity is one on the Gladstone township. The tungsten mineral is in association with tin, and a small parcel of ore was obtained. The present appearance of the lode in the workings is not very encouraging, but the spotty habit of wolfram occurrences is well known.

IV.—ALLUVIAL MINING.

(1)—THE MUSSEL ROE DEEP LEAD.

The height of Gladstone above sea-level is nearly 300 feet; the country to the north of it is lower, sloping down gradually to the sea-shore. There is reason to believe that at one time in the Tertiary period the general elevation of the country about here was considerably higher. The land near Gladstone was then intersected by rivers, which collected tin ore from sources in granite country all round Mt. Cameron, and far to the south. The Scotia River at that time headed from Mt. Cameron, flowing north right across the line of the present Ringarooma River; and the Great Mussel Roe River seems then to have flowed a little west of its present course. On the old Great Mussel Roe Proprietary's section the ancient channel lies east of the present river, from which it is there separated by a low ridge of granite. It continues north through Carroll's Flat, but appears to have crossed north-west to the other side of the river at the North Mussel Roe Proprietary. The lead then keeps to the west of the river, and no indications exist of it recrossing.

Before considering its further course, it should be mentioned that during this period a land subsidence set in which brought the sea over the country to the foot of Mt. Cameron and right up to the Edina and Amber Creek ground. The sea redistributed the river gravels, and covered the country with a fine white quartz gravel drift. The mixture of freshwater and marine deposits which was thus brought about makes it difficult always to distinguish between the two classes of drift. The river deposits have been scattered and cut up by erosion and earth movements until it often becomes impossible to trace, or even guess, at their course. At any rate, the buried leads near Gladstone and Mt. Cameron finally terminated by running out to sea when the shore-line was nearer Gladstone than it is now.

Reverting now to the Mussel Roe lead, it is quite clear that it continues west of the river as far north as Watt's (subsequently the Cybele). The Government bores show that there was no outlet for it further north. The deepest bore in this ground was shallower by 22 feet than the gutter proved by the Edina bores, so that it seems likely

that the lead bears away south of Watt's, in a north-west-erly direction. The whole district having been raised, it is impossible to trace the old channel in a continuous line, and the various isolated deposits of drift which survive at intervals have to be relied upon as the indications of its general direction. The interpretation of the broken sections of the lead is difficult, and the conclusions which may be drawn are open to argument.

More or less deep ground exists towards the Garfield and Tamar claims. It can be traced on high land as far as the Tamar workings, where it comes to an end against the granite rock of the Empress Hill.

The slate and granite rock south of the Garfield appears to be the southern rim rock there. The junction of slate and granite takes place in the Tamar workings. The Tamar drift is a clayey white and ironstained sea sand, with pebbles of sandstone, slate, and quartz, containing in one part of the deposit drift timber converted partly or entirely into lignite. The wood has been determined by Mr. H. H. Scott, Curator of the Victoria Museum, as belonging to some species of cedar. This, the lower part of the deposit, may have been a river lead or lagoon, while the upper marine sands represent a period of sea action during which the old freshwater channels were filled in and obliterated.

North of the Tamar workings the body of drift is cut off by the Tamar Creek valley, north of which, again, is a ridge of hard slate, blocking a further extension of the lead in that direction.

Thus, the Tamar valley marks the northern limit of the run of deep ground along which it is believed that the ancient Great Mussel Roe River flowed. Beyond the Tamar workings everything is conjectural.

Further north-west is the Lochaber deep deposit. Some driftwood has also been found in the gutter here. Although this deposit is detached from the high Tamar ground by both the Tamar and Pig and Whistle Creeks, and cannot be connected with it by intermediate deposits, it seems possible that it is the marine filling of the old lead. Any attempt to trace the direction of the lead beyond this point would be based on very slender clues. It is permissible to surmise that it opened out towards the Stinking Creek marshes, and lost itself in the open sea.

There has been so much discussion round the question of this lead, and so many fruitless attempts to find a well-

defined stanniferous gutter, that many have been led to doubt whether there ever was a fresh-water channel apart from the present river. But the ancient run at the Proprietary is very distinct, and beginning from this starting-point, the deep ground to the north, and then north-west, indicates no relationship to the existing river. It is true that the old river gutter does not persist; it has possibly been cut up and destroyed by the sea. But given a distinguishable channel at one point, it must have reached the sea somewhere. How it did so has been suggested above; for more precise information it will be necessary to wait till further data have accumulated.

If prospecting is directed simply towards locating concentrations of ore, irrespective of whether they have collected in river leads or on ocean beaches, it will have greater chances of success than if restricted to the search for fragments of a gutter, which, it must be admitted, has nowhere given evidence of being very rich. The experience which has been gained by all the boring and active work in the Gladstone district tends to show that the marine deposits and the mixed marine and fresh-water terraces have been more important as sources of supply than the purely river leads.

In 1902 the Government put down lines of bores in six localities, with a view of ascertaining whether the Great Mussel Roe lead contained payable deposits of tin ore. These lines are shown on the map accompanying the present report. No. 1 line of six bores was 10 chains in length across Carroll's Flat, and traversed the ancient Mussel Roe lead to the east of the existing stream. The second bore revealed the gutter at $49\frac{1}{2}$ feet from surface with 3 inches of quartz wash, carrying a little tin ore, but not payable. The first bore met with 3 inches of gravel, with good tin at $7\frac{1}{2}$ feet from surface, and 3 inches of pug and drift, with a little tin, the whole just payable for wages men. The third bore, at $9\frac{1}{2}$ feet, went through 18 inches of wash, with fair prospects of tin and a good deal of iron; and at 32 feet a bed of drift 8 feet 4 inches thick was found lying on the bedrock, and carrying a little tin.

No. 2, or the Edina line, consisted of 11 bores, and was 20 chains in length, across the Crown land lying between the No. 5 syphon at Edina Flat and the Great Mussel Roe River. The bores were 2 chains apart, and the sixth bore bottomed the gutter at a depth of $54\frac{1}{2}$ feet. The

ground passed through consisted mostly of pug, with a little fine drift. No tin was obtained anywhere on this line. A few colours of gold were obtained in the 10th bore in fine drift lying on granite at 22 feet.

No. 3 line of 32 bores was 108 chains in length, nearly $1\frac{1}{2}$ mile of the preceding, beginning with 11 bores, in a northerly direction, continuing with 12 bores north-easterly, and finishing up with nine bores easterly towards the Mussel Roe River. The 28th bore went down in the deepest channel on this line, touching the bedrock granite in a gutter 84 feet from surface. This, however, is still shallower than the gutter proved in the Edina line, and seems to show that there was no outlet for the lead to the north. The inference is that it turned west or north-west south of the first bore on this line, and between it and the Edina line. Tin ore was met with in eight of these bores. No. 1 bore, at $4\frac{1}{2}$ feet from surface, passed through $3\frac{1}{2}$ feet of wash, with $1\frac{3}{4}$ lb. tin to the cubic yard. No. 2 bore, at $51\frac{1}{2}$ feet, showed 8 inches of pebbly wash, worth 3 lb. tin per cubic yard, and below this was fine drift 16 feet 10 inches and pug 6 inches, carrying a little tin. Below the soil, in No. 3 bore, was drift 3 feet 11 inches, with a little tin. No. 7 bore, at $4\frac{1}{2}$ feet, entered drift for $18\frac{1}{2}$ feet, with a little tin. In No. 10 bore, at 20 feet, was a bed of fine drift 2 feet thick lying on the granite, and worth 29 lb. tin ore per cubic yard. No. 11 bore, at $4\frac{1}{2}$ feet, showed $1\frac{1}{2}$ feet of wash, with a little tin, and the bottom wash at $12\frac{1}{2}$ feet also carried a little ore. No. 19 bore, at 11 feet 3 inches, showed 2 feet 3 inches of pebbly wash, with a little tin ore; and in bore No. 31 wash 3 feet 3 inches thick, with a little tin, lay on the granite bottom at 21 feet.

No. 4 line was from the Tamar workings north-easterly, in order to ascertain whether any deep run of ground extended towards the Empress dam. There were only three holes put down on this line. No. 1 bore was the deepest; it was put down on the top of the hill east of the main face, and struck slate at 64 feet from surface, after passing through $1\frac{3}{4}$ feet of surface-wash, with a little tin ore. No. 2 bottomed on the slate at 32 feet, and No. 3 at 4 feet 8 inches. The bed-rock in the deep ground at the summit of the hill is 145 feet higher than the gutter on the Edina line. This fact illustrates the puzzling effects of the rising earth movements which have broken up the lead in various places.

No. 5 line consists of 32 bores on a length of 91 chains, beginning at the south-west corner of Galloway's Consolidated lease, and running north-east across Stinking Creek marshes. This is an important line, as it would intersect any continuation of the Great Mussel Roe lead as interpreted in this report, as well as any possible continuation of the Scotia tributary lead. There are no less than seven depressions in the bedrock along this line of bores, but only two of them are really deep. One of these is close to the old 56 feet shaft (Bell's shaft), where No. 17 bore struck the slate bottom at 84 feet from surface. Both tin and gold are alleged to have been obtained from the shaft, but no mineral was shown by the bore. The register of this bore, kept by Inspector Griffin (who carried out all these drilling tests with great care), is as follows:—

Fixed datum, 500 feet.

Depth Bored. ft. in.	Total Depth. ft. in.	Below Datum. ft.
—	—	78·40 collar of bore
0 9	0 9	79·15 Fine sand
1 9	2 6	80·90 wash
2 6	5 0	83·40 yellow pug
8 6	13 6	91·90 Fine sand
63 6	77 0	155·40 layers of pug and drift
3 6	80 6	158·90 angular wash
2 6	83 0	161·40 fine drift
1 0	84 0	162·40 carbonaceous silt
1 6	85 6	163·90 soft slate bored into 1½ feet

Total depth of bore to bedrock, 84 feet.

The greatest depth was attained in No. 27 bore at 76 chains along the line, where the slate bottom came in at 114½ feet from surface. This bore is in the middle of the Stinking Creek marsh. Its register, as kept by Inspector Griffin, is as follows:—

Depth Bored. ft. in.	Total Depth. ft. in.	Below Datum. ft.
—	—	128·37 collar of bore
0 9	0 9	129·12 turf
1 9	2 6	130·87 fine sand
1 6	4 0	132·37 brown cement
30 0	34 0	162·37 layers of drift and pug
1 0	35 0	163·37 angular wash

Depth Bored. ft. in.	Total Depth. ft. in.	Below Datum. ft.
8 0	43 0	171'37 coarse drift
3 6	46 6	174'87 grey pug
4 0	50 6	178'87 carbonaceous silt
6 6	57 0	185'37 angular wash
4 0	61 0	189'37 carbonaceous silt
1 0	62 0	190'37 fine sand
13 0	75 0	203'37 angular wash
17 0	92 0	220'37 carbonaceous silt
4 0	96 0	224'37 brown sand
2 0	98 0	226'37 carbonaceous silt and lignite
1 0	99 0	227'37 fine sand
13 6	112 6	240'87 carbonaceous silt and lignite
2 0	114 6	242'87 brown sand
0 6	115 0	243'37 hard slate

Three chains further along this line bore No. 28 passed through $6\frac{1}{2}$ feet of wash, with a little tin at $34\frac{1}{2}$ feet, and $3\frac{1}{2}$ feet of wash, also with a little ore at $43\frac{1}{2}$ feet, and 2 feet of angular wash with a little ore at 83 feet. A foot of angular wash with a little tin ore was passed through at 8 feet in bore No. 29. The 12 feet of sub-angular wash which overlies the slate bedrock in this bore at 82 feet is similar in character to that of the Lochaber, but it carries no tin.

From bores Nos. 23 to 30 the bedrock forms a deep channel a quarter of a mile wide with a rock bank on the north side 84 feet high. The gutter at the bottom of this channel is 35 feet below the channel on the Edina line. There are, however, too many channels or depressions intersected by this line of bores, and too close together for them to be interpreted as being separate stream courses. The probability is that they represent the uneven land surface when the deposits of sand and gravel were laid down. The pug and silt were possibly the estuarine and backwater sediments of the retreating sea. If by any possibility the deep channel marks the former Mussel Roe and Lochaber line, it has been scoured out and refilled with barren drift. The Scotia lead, as it comes north, will evidently widen out and merge into barren marine drift.

No. 6 line of bores was a short line of four bores 3 chains apart put down in the old McGregor workings, in

the Aberfoyle country. The deepest bore was 58 feet below the surface, when it struck granite. In the No. 2 bore $2\frac{1}{2}$ feet of wash, with a little tin ore, lay upon the bedrock at $42\frac{1}{2}$ feet. There is nothing here which can be connected with the Mussel Roe lead. That lead must have terminated far to the east of this. If a conjecture may be hazarded, a large estuary or arm of the sea once existed between Mt. Cameron and the ridges north of Stinking Creek marshes, and this, perhaps, received the Scotia River, and, in its upper part, the ancient Mussel Roe River. It collected the carbonaceous silt and pug met with in many of the bores, and itself may at one time have debouched hereabouts into the open sea.

(2)—THE EDINA AND AMBER CREEK COUNTRY.

This tract of country is on the right bank of the Ringarooma, between 3 and 4 miles south-east of Gladstone. It is strewn with a good many old claims, but at the present time work is being carried on at only a few points. The most important of these are the claims of Rankin and Ogilvie (Barnes) and of Torley and Groves. The deposits are being opened up and developed by active and profitable work.

New Edina (Rankin and Ogilvie: 6987-m, 5 acres; 6231-m, 5 acres).

The present workings are on Section 6231. There is a continuous area of old workings from here westward to the Ringarooma River, and the run of tin-bearing ground passes across to the old Enterprise, cutting the modern river system at right angles. The drift at the Enterprise, however, is of a different character and appears to have been derived from Mt. Cameron.

The late Mr. Ogilvie worked the old Edina Flat for a good many years. This is largely a shingle deposit overlain by sand drift, with small pebbles. At one time Mr. Ogilvie was winning between 1 and 2 tons of tin ore per month from these flats.

On examining the old workings, large deposits of shingle are seen, consisting of sandstone, slate, quartzite and vein quartz, the stones of quartz being very numerous. A peculiar feature is the occurrence in the shingle and drift of

huge masses of tabular siliceous rock, known locally as "cement" or "clinker." Much speculation has existed as to whence these boulders have been derived, and by what agency they have been brought into their present positions. In some instances the masses must be several tons in weight, and their shape as well as size precludes the supposition that they could have been washed up here by the sea or transported by a stream. Their flattened shapes show clearly that they have not been carried by water, though some of the smaller ones may have been disturbed and rounded by flowing water. Waterworn inequalities of surface and potholes in the stone indicate the action of water on an uninterrupted horizontal surface, and not on mere boulders which would have been worn into more rounded shapes.

The only feasible explanation of the occurrences is that these blocks of stone have resulted from the breaking up of cemented layers of drift *in situ*.

This appears likely when it is borne in mind that such eminences as the Edina Sugar Loaf and others, and the country northwards, consist largely of partly consolidated quartz drift in various stages of cementation. This sort of drift exists at intervals all over the country as far north as the Aberfoyle. Although the localities where it is now found are widely separated, they were connected originally, and the various hills and ridges of cemented ground are simply survivals of a once widely spread sheet of marine wash covering the whole of this area. Anyone looking at the Edina Sugar Loaf can readily imagine that the cement bed of which it consists once covered the surrounding country, burying the leads under a tremendous overburden.

The cement itself is composed of waterworn grains of quartz, sometimes friable and of quite loose texture, or again possessing the hardness of solid sandstone and resembling the miners' "porphyry." An infiltration of silica has in the extreme stage cemented the drift into a solid rock of excessive hardness and ringing under the hammer with a metallic sound. This is the veritable "cement" or "clinker."

The old Edina shingle wash is west of the New Edina, and when it reaches the latter it ceases abruptly, its edge overlapping the wash now being worked by Mr. Barnes. The size of its pebbles and its proximity to the present Ringarooma are at first blush suggestive of it having been the former bed of that river. But the nature of the stones—quartzite, slate, sandstone, &c.—strongly negatives that sup-

position. The Ringarooma River flows through granite country all the way from Derby (excepting a small bar of slate at Derby itself), and cannot have furnished this assemblage of various stones. South of the Edina granite country extends to the Blue Tier ranges, and east nearly to the sea, so that the profusion of different stones must have come from the north. The only agency which can have brought them from that direction is the sea, and the inevitable conclusion is that these terraces are marine.

An extreme stage of silicification characterises certain zones in the shingle beds; the shingle itself is sometimes cemented and forms a conglomerate "clinker" rock.

As said above, going eastwards to the Mussel Roe divide, the shingle beds cut out and the Mussel Roe basin is entered. This takes place west of the actual geographical divide, for the workings in the New Edina are already in the ground drained by the ancient Great Mussel Roe River. This is clearly shown by the strong admixture of ilmenite (titaniferous iron oxide) with the tin ore, reducing the assay value to between 68 and 69 per cent. This iron content is characteristic of the Mussel Roe ore, and is not noticed in the deposits on the Ringarooma fall.

The deposit shows a descending section of 14 feet of soil and pipeclay resting on 10 to 15 feet of granite drift, at the bottom of which is a layer of tin-bearing gravel from 6 inches to 9 inches thick, and occasionally up to 1 foot. Below this is the granite bedrock. All the best tin lies on the bottom. The granitic drift bed contains no tin, but an abundance of iron. Lately a lower bed of tin-bearing white quartz wash has been struck a few inches below the upper bed, and filling the hollows and depressions in the bedrock. When the bedrock rises this bed disappears, from which it would appear to be a more ancient deposit. It is also free from iron or driftwood.

The average value of the ground worked on these flats is supposed to be about $\frac{3}{4}$ lb. per cubic yard.

Blackened and charred driftwood is found in the ground to the north of the main workings. A specimen of this was examined by Mr. H. H. Scott, Curator of the Victoria Museum, who reports as follows:—

"In its microscopical structure this wood departs from the true and typical pines and manifests characters similar to those found in the wood of the modern yew trees. In brief these may be stated as follows:—(1) Wood of close, even texture; (2) cells uniformly marked with spiral bands; (3) no ducts as in true pines."

Coniferous and other driftwood is common in several of the tin gravels and silts of the Gladstone district, *e.g.*, at the Tamar, the Scotia, the MacGregor, &c.

In the ground to the north of the New Edina there is some tin, with abundance of bog ironstone (limonite); the ground immediately east is tin-bearing also, and is expected by the lessees to give work for several years to come. Further east, between the No. 5 Syphon and the Mussel Roe River, the Government bores failed to disclose tin, but it will be interesting to watch whether actual work will reveal ore missed by the drilling operations. The Edina Sugar Loaf, to the south, is too heavy a pile of drift to make it profitable to test the wash beneath it. The New Edina is using water from the Government race, with a Pelton wheel, and 2½-inch nozzle in the face. The output is about 2 tons per month, and the prospects of the mine are healthy.

There is apparently a run of country between here and the Cybele, to the north, which needs prospecting. Some of it probably is very poor in tin, but the likelihood is that payable patches would be found in the course of a systematic examination. The surface deposits are marine drifts, and poor, but it is quite possible that remunerative wash will be found either in the bedrock or at some intermediate horizon.

Groves and Torley's Sections (7087-M, 3 acres; 7107-M, 5 acres; 7097-M, 5 acres; 7086-M, 10 acres; 7407-M, 5 acres; 7408-M, 10 acres; 7088-M, 10 acres; 7089-M, 5 acres).

These are a group of sections situated on the divide between the Amber and Peacock's Creeks, 1½ mile southwest of the New Edina, and ¾-mile south of the Ringarooma River. The country rock is granite, covered with unconsolidated granitic drift, forming a loosely aggregated and partially cemented sand. This sand carries a little tin all through it. On the bedrock on Section 7087 is a productive tin wash of small rounded quartz pebbles, and averaging over a pound of tin oxide per cubic yard. The wash is generally 2 or 3 feet thick, and has attained a maximum of 5 feet. Some unusual yields are stated to have been obtained from the cement a foot or two below the grass roots, where as much as 30 lb. to the yard has been recorded.

The ore is of high grade, assaying 74.5 to 74.7 per cent. The outlook at this mine is encouraging, as the ground con-

tinues to the south-east and has been proved as profitable immediately ahead of the existing workings.

Nearly half a mile east of the above are large workings, 60 to 70 feet deep, on Section 7089. The depth here is too great for working in dry seasons. The ore is associated with pyrites, but the present workers of the lease have succeeded in bringing the assay value from 68 or 69 per cent. up to 72 per cent. The same kind of wash and bedrock exists here, and the two workings are evidently in one and the same deposit of drift. The pyrites is marcasite, the variety of pyrite which is secondary and dependent on the presence of organic matter. It occurs in the mine frequently in concretionary, nodular forms.

There seems to be a great run of deep ground here, extending over the high land for great distances. Some of this will no doubt be found to be of value, and the area is one which it would be advantageous to test by prospecting. Its ancient geography is somewhat difficult to reconstruct, but it may be inferred that the cement drifts are of marine origin, filling in and burying freshwater leads, the sources and directions of which are at present quite unknown. Although the lease workings are on ground between Amber and Peacock's Creeks, the deposits are not related to these streams in the slightest degree.

The most satisfactory feature of the present enterprise is that there appears to be a long period of profitable work in view.

J. Rushton's Claim.

Mr. Rushton is working a miner's claim south of the Edina, at the head of a small gully leading down to the Ringarooma. The face is composed of heavy shingle, which rests on the granite, and the yield is stated to be fair. No iron is associated with the ore here.

(3)—TERRACE GRAVELS NEAR THE GLADSTONE TOWNSHIP.

These are situate within the loop which the Ringarooma makes to the north of the township, and are mostly being worked on tribute. They form a set of terraces descending successively from the level of the town down to the river banks. They were worked in the early days of mining here, and intermittently since, being idle for long periods at a time. Some of the old deposits, given up as unprofitable, are now being reworked and made to pay.

The high-level drifts contain small waterworn pebbles of quartz and the sedimentary rocks, but there is an absence

of the heavy shingle which comes in as river level is approached. They do not occupy any well-formed channels, such as would be left behind by rivers: they may represent deposits left behind by the retreating sea. Bell's Flat, on the other hand, illustrates the deposits of river shingle.

Several sections on which high-level drifts occur have been taken up by Mr. Ware. The workings on one section show the drift 35 feet deep. In the grass at surface there is a thin layer of fine sea-sand, passing down into a yellow ferruginous cemented clay with rounded quartz, slate, and sandstone pebbles, below which is the white drift, evidently from a granitic source. This drift carries a little tin all through it, but what is called the wash proper lies on the bedrock. The drift is apparently deepening towards the west, but is flat-bedded, as may be seen by the horizontal layers of pebbles alternating with the finer sediments. From the nature of the grains, the drift has not travelled far. The absence of granite from the wash is remarkable considering the nature of the drift. The tin ore obtained is black and clean: dish prospects show a little gold in fine colours.

On looking down from here to Bell's Bridge it may be easily seen that the high land on the other side of the river was once continuous with that on this side. Accordingly, the Ringarooma here has cut down through older deposits, and these terraces consequently antedate the present Ringarooma. The present river may at one time have flowed over them, for there are decided signs of it having cut its channel down east and north in recent times; indeed, the process is probably continuing now.

Some old workings exist on Bell's and Ogilvie's purchased lots, now Galloway's. A little work is proceeding on Galloway's face, where a foot of wash yields a little tin.

All this area has been looked over repeatedly, and a good deal of it has been worked, but there seems reason to believe that many of the deposits will afford employment for a long time to come. Although much of the ground is poor, rich pockets exist in quite unexpected places; Mr. Galloway won quite a substantial quantity of tin from a small excavation in the high terrace drift a chain or two from the main street of the township.

(4)—THE EMPRESS LEAD.

This is a well known old claim on the granite range which forms the divide between Harden's Ravine and the Tamar

Creek Valley. The lead is situate in a saddle on the range, which it cuts through at right angles in a north and south direction, so that each extremity of it terminates on the opposite side of the saddle. In this way only a short section, about 800 or 900 feet, of the original lead has survived. Whether the gutter emptied itself to the north into the ancient Mussel Roe lead, now entirely removed by denudation, or whether it was of later date, is difficult to say. At any rate, perched up there on the mountain neck, it illustrates the tremendous extent of denudation which has been effected in quite recent times, and no wonder need be felt at the breaking up and disappearance of the Great Mussel Roe lead in this part of its course.

The bedrock at the Empress is a coarse, dark-mica granite, which passes into a tin-bearing quartz-mica rock. The thickness of the drift is about 25 feet. The wash lay apparently in a shallow channel of the bedrock. A section of the walls of the cutting shows ferruginous sand and clay at surface, and below this gravel and gravelly sand, which doubtless reposed on the coarse tin-bearing wash of the gutter or depression in the granite floor. There is a striking profusion of stones of reef quartz all over the old workings, some of them measuring up to 2 feet in diameter. Good quality coarse tin is stated to have been won from this lead.

(5)—TAMAR CREEK VALLEY WORKINGS.

This valley has been excavated since the date of the deep lead period, and the deposits in it are, comparatively speaking, modern. It has received some of the tin contents of the granite on the range south of it, and work has been commenced lately on one or two claims with satisfactory results so far. Messrs. Long and Richardson have recently started work where the creek flows by the Cape Portland Road. The wash is from 6 inches to 1 foot thick, and the prospects are promising. Orton and Son are working in clayey drift 100 yards up from the road and a couple of hundred yards north of Ware's pipe-line. The face is about 12 feet deep, with a couple of feet of wash making towards the Empress Hill. The bottom is slate. The owners hope that there will be found some sort of a gutter which they will be able to follow. The probability, however, is that the deposit is part of the general filling of the valley. Fairly good results are being obtained for a start.

(6)—THE DEPOSITS OF THE GREAT NORTHERN PLAIN.

By this name are designated the gravels which form the surface of the country between the Lochaber and the Aberfoyle. Some of the area is treeless, some of it covered with open timber, but in a general way there is not much difference of level between one part and another.

The Lochaber workings have produced fair tin in their time, and a little work is still being done there. The clayey gravel and sand which are met with here betoken marine action of some kind, and it is just possible that these deposits indicate the lower part of the Mussel Roe lead near its connection with the sea.

(a)—Section 5359-M (20 acres)

is between the Scotia and the Lochaber, north-east and adjoining the 5-acre residence reserve of the Mt. Cameron Water-race. Some tin has been recently won from a deposit here. The face of the workings shows for 7 or 8 feet, the upper part of it consisting of white sand carrying an abundance of white quartz stones. A soft granitic-looking sand forms a false bottom, the real floor being slate, as may be seen lower down in the tail-race. Some interest attaches to the deposit, in that an "obsidian button" (Australite) was found by Mr. Mallinson on the bottom at 8 feet from the surface.

(b)—Scotia Mine.

The leases of this mine are in the name of James Galloway, and are 4752-93M, 20 acres; 4121-93M, 40 acres; 4222-93M, 40 acres; and a consolidated lease, 6295-M, 240 acres.

The mine is a very old one, but was taken up and opened out by Mr. Galloway with highly satisfactory results for some years. The output however fell off, and it has now been idle for some time.

The workings occupy a large area of the three central sections, and are in a body of drift fully 60 feet deep. The quartz drift contains pebbles of quartz and sandstone, with some waterworn pieces of "cement." One large boulder of the latter seems to be almost *in situ*. It is stated that the ground began to be payable at about 10 feet from the surface.

PLAN OF SCOTIA OPTION BORES,

No. 3 Line of Bores.

No. 26.	No. 27.	No. 28.	No. 29.
⊙	⊙	⊙	⊙
56'	66'	68'	53'

Lines 3 chains apart.

Bores averaging 40-ft. apart.

W.

E.

No. 2 Line of Bores.

No. 25.	No. 24.	No. 23.	No. 22.	No. 21.	No. 20.	No. 19.	No. 18.	No. 17.	No. 16.	No. 15.	No. 14.
⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
57'	60'	64'	57'	68'	66'	55'	55'	55'	52'	52'	40'

No. 1 Line of Bores.

No. 10.	No. 9.	No. 8.	No. 7.	No. 6.	No. 5.	No. 4.	No. 3.	No. 2.	No. 11.	No. 12.	No. 13.
⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙	⊙
48'	64'	64½'	65'	68½'	52'	58'	65'	65'	65½'	66½'	52'

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The bedrock, which is slate, rises towards the south until it reaches the surface, but deepens slowly going north. The bottom as a whole is rather flat, and has an irregular surface.

Although there is no confined gutter, there does appear to be a general direction in which the ore-bearing drift trends, and consequently it is best described as a lead. It may be inferred that its source was in high ground on the south side of the present river. The stones of smoky quartz, topaz, and sapphires, which are met with in the drift, point unmistakably to its origin in the Mt. Cameron country. It would therefore antedate the modern Ringarooma, and perhaps be coeval with the Mussel Roe lead. It might be expected to junction with this a little further north, if the latter has not been destroyed by the inroads of the sea.

Within a chain from the face Mr. Jolly put down three or four bores; with these, and the lines bored by Mr. C. E. Ryan under option, the direction of the channel in a north-westerly direction may be said to be almost established. The nature of the channel or channels, however, is open to doubt.

Examining the figures which Mr. Ryan has kindly communicated for the purposes of the present investigation, it is seen that three lines 3 chains apart have been bored by him along an east and west course, No. 1 line being about 300 feet north of the Scotia face. This line comprises 12 holes. Line No. 2 is 3 chains north of No. 1, and also comprises 12 holes. Line No. 3 is 3 chains north of No. 2, near the western end of the ground bored, and comprises four holes. The lines are thus evidently designed to test the apparent Scotia channel of deep ground ahead of the actual workings. This channel is about 100 feet wide, as disclosed in the bores, and the deepest gutter is about 68 feet deep from the surface. A maximum of 68 feet was reached in one of the holes in each of the lines of bores.

If the results of No. 1 line are closely scrutinised it is seen that there is a ridge of bedrock in the middle of the line, perhaps a chain wide, and rising to within 52 feet of the surface. This ridge contributes to the formation of another broad depression at the east end of the line, about 65 feet in depth.

The 68 feet depression in the bedrock is shown by bores Nos. 6, 21, and 28 in the three lines as trending N. 20° W., which would bring it into the middle of the consolidated 240-acre lease near the 56-foot shaft (Bell's shaft). No one appears to know much about the results obtained in sinking the shaft, though rumour says that both gold and tin were

obtained. The Government bore line, however, passes close to the shaft, near which bore No. 17 bottomed on the soft slate at a depth of 84 feet. The ground passed through was fine sand and wash, pug, and carbonaceous silt, without any traces of tin. Bore No. 16, three chains south of this, did not bottom at 72 feet, on account of the loose nature of the drift, which prevented the tubing being got down without driving; but bore No. 15, three chains still further south, revealed a gutter 102 feet from surface, filled with 5 feet of subangular wash, with a little fine tin, but not payable. It is significant that this gutter is on the line which the Scotia lead would take if it lives so far north as this.

What makes it difficult to draw any positive conclusions is the circumstance that two more gutters exist on the Government bore-line further north, the one 10 or 15 chains from this one, and 110 feet deep; and the other in the middle of Stinking Marshes, 114 feet deep. The latter may possibly indicate the continuation of the Lochaber run. The bedrock at No. 15 bore is between 50 and 60 feet lower than at the Scotia, from which it is distant about 50 chains, and this gives a grade of about a foot in a chain.

Consequently there would seem to be an outlet for the Scotia lead in the direction of Bell's shaft, but it is not easy to determine the real nature of this outlet. The channel may not be the lead itself, but a depression of the floor of the sea into which the ancient Scotia flowed. There are one or two features which suggest that the floor of the Great Northern Plain has been reached, carrying all sorts of anomalous depressions in its bedrock surface. A curious and at present an inexplicable fact is that the apparent Scotia lead has become very narrow at the northern face of the workings, compared with what it was further south. The fact of the three parallel channels shown by the Government bores at 102 feet, 110 feet, and 114 feet, within a distance of half a mile, is rather against the idea of these representing the courses of three ancient rivers.

On the marine theory, the northern Scotia workings are heading for one of the irregular depressions of the sea floor in front of the mouth of the ancient Scotia river. These depressions are not necessarily barren of tin, but the concentrations of ore are likely to be irregular, and not always on the same horizon, but forming false bottoms here and there. The coexistence of angular with waterworn wash at the bottom of the bores suggests the close proximity of its source.

Mr. Ryan's work on No. 1 line showed tin at bores Nos. 2, 3, 6, 7, 8, 9, 11, and 12. Bore No. 11 had the highest yield, viz., 1.78 lb. per cubic yard; Bore No. 8 yielded at the rate of 1.028 lb. per cubic yard; Bore No. 9, .87 lb., and the remaining bores on this line from .33 lb. down to traces.

The bores Nos. 19, 21, 22, and 23 on No. 2 line, gave .317 lb., .121 lb., .04 lb., .443 lb. per cubic yard respectively; and bore No. 28, on No. 3 line, yielded at the rate of .524 lb. per cubic yard.

So far as these lines have shown anything at all, it is that the channel at that distance ahead of the Scotia does not contain payable wash except in one or two places where there has been some special concentration of mineral. The ground passed through is reported as being principally sand and pug, which points somewhat to estuarine conditions.

So long as the workings were in the freshwater gutter the Scotia mine yielded very profitable quantities of tin ore, and was a highly valuable adjunct to the Gladstone field. Its future now appears to depend upon the result of close exploration of the ground in front of it, though the results of search have been, so far, it must be confessed, rather disappointing. If the ground to the north and north-east can be shown to include deposits of any importance, the mine would acquire a new lease of life.

(c)—*The Doone Mine.*

This comprises two 5-acre sections, 7141-m and 7142-m, and 7363-m, 2 acres, held by Messrs. Richards and Murray, and situate on the north side of the Ringarooma, half a mile north-west of the north-west corner of the Filumena reserved township. The old Doone workings adjoin them on the north-west. At one time, and for many years, a very good tin yield was obtained from these. Soft clay, slate, and sandstone form the bedrock. The drift is made up of granular quartz sand, with irregular layers of medium-sized pebbles of quartz, slate, and sandstone. Micaceous quartz and stone from the granite area also occur associated with pebbles of quartzite and metamorphic slate. There are likewise a few waterworn stones of "clinker" or cement.

The present owners found the new deposit on Section 7142 by boring, in which they enjoyed a measure of good fortune, for if the position of the bore had varied by the

distance of only a few yards, the discovery might not have been made. Operations were started in October last.

The face is from 15 to 25 feet in height. Below the grass is a hard, poor sand merging downwards into a drift with small pebbles all through. Below this about 3 to 5 feet of wash rests on softened sandstone and clay slate bedrock.

The wash contains frequent stones of tin-bearing vein quartz (apparently from the Mt. Cameron country), sandstone, slate, chalcedony, and cemented drift "clinkers." All these are shapeless, and do not recall the forms met with in ordinary river shingle. An odd stone or two of smoky quartz from Mt. Cameron is met with now and again. The wash stones are characterised largely by silicification. The tin, as a rule, is finer near the bottom. A little tourmaline and iron, as well as gold, accompany the ore, the iron principally in the upper part of the deposit.

The width of the gutter is not yet known; it apparently runs west of north. There is a possibility that the channel may be an irregular broad depression in the rock floor, such as would occur on a sea-beach, rather than the confined course of a stream; but a continuance of the work will soon clear up this point. The results of the work so far are very encouraging.

In the loop of the river about a quarter of a mile further south are some old workings on what was part of the former Doone property. The shingle which was worked here for tin was probably at one time the river bed. The excavations are now filled with water and flood silt, but some nice tin was won from here until the ground became too heavy some 30 or 40 feet down.

About 300 yards east of where Richards and Murray are working is a large excavation which shows the same kind of ground and soft bedrock as on the 5-acre sections.

The success of the present work here shows the possibilities which exist on this plain, where unsuspected deposits may be revealed if prospecting is persevered with.

(d) The Aberfoyle and Macgregor Country.

This country lies north of the Ringarooma, at the western end of the Great Northern Plain. There is a wide area of sand and gravel here, possessing the characteristics and appearance of beach deposits. It has not been bot-tomed in the various workings, except at the Aberroe

Mine. The bedrock in the southern part of the field is mostly granite, while in the northern part it is probably slate. The drift has evidently not been derived from streams flowing down in ancient times from Mt. Cameron, for the smoky quartz stones characteristic of the mount are practically absent, and the fine sand is also unfavourable to the supposition. The quartz grains of which the sand on these flats is composed are well worn and of even size, implying long and continuous battering and tossing, such as would take place on a seashore.

(1) *Aberroe Tin Mining Company*.—This company is working the old Aberfoyle and You Hen's sections on the north side of the Ringarooma, and has carried on operations here for about eight years. It has paid its way, and would pay handsomely if water could be got all the year round; as it is, half a year's work has to be weighted with the balance of idle time. For the past half-year the results have not come up to expectations, owing to somewhat lower tin values having been recovered, and to the cost of necessary development work. The average value of the ground worked during this period has been about two-thirds of a pound per cubic yard. The top sand is barren or poor in tin. Below this is tin-bearing sand passing down into wash containing a little tin. A bed of shingle 8 or 9 inches thick rests on granite. The tin is good quality, assaying 74 per cent., sometimes 74·6 per cent., and no seconds. The size is all fine, and no specimens. It is singular that between the workings and the river is a bar or ridge of granite, so that the deposition of the material was in a basin or gutter in which the drift slopes away from the modern river. The same feature was met with in the old Canary claim a little to the north-east. The assumption that there was a river at one time parallel with the modern course of the Ringarooma is one explanatory of this, but does not seem to account for everything. The northerly slope of the beds of drift is somewhat suggestive of a marine beach. Deeper ground, 60 feet, was found by boring on the 5-acre dam-site, and this seems to put the river theory out of court. It gave rise to a belief that there was a channel extending in that direction; but, on the other hand, some bores further north-east put down for the Cape Portland Company are said to have struck shallower ground. These apparently conflicting data only show that the river supposition involves inconsistencies which it is difficult to reconcile.

(2) *Sections 6620-M, 20 acres; and 7394-M, 10 acres (G. S. and A. H. Mallinson)*—These are west and adjoining the main workings of the old MacGregor.

Work is being carried on actively on an unbottomed drift deposit near the southern boundary of the section, the deepest ground so far being about 16 feet. The bulk of the drift may be described as a marine sand carrying small stones. This rests on a layer of tin-bearing fine sand, varying from 18 inches to 4 feet in thickness. Below this is a boulder bed of soft clay containing large water-worn boulders and stones of quartzite, sandstone, and vein quartz. A few stones of granite are occasionally met with. The lowest bed encountered in the workings is a coarse barren sand.

The immense boulders are such as might very well occur on a sea-shore. If this is actually the case it would seem that there is hardly any limit to the chances of discovering concentrations of ore anywhere in the drifts of the Great Northern Plain. The ground which is being worked at present is stated to be worth about 1 lb. to the cubic yard, and very encouraging results have been obtained from bores in the ground ahead of the workings, and extending right through the section, and even beyond its northern boundary. The bores have indicated the existence of an ore-channel of some kind in the false bottom, but its true nature will be more apparent after a little more work.

(3) *Sections 7092-M, 5 acres; 7037-M, 10 acres; 7038-M, 5 acres (H. G. Beltz)*.—These sections are north-east of Mallinson's section, and are situated geographically on the same plain. The ground seems to be another part of the same general deposit, though the huge boulders are absent, and possibly it was a little further out seawards. The two hills in the neighbourhood (Brown's or the Aberfoyle Hill and Little Hill) are composed of consolidated and partly-cemented quartz drift, which at one time evidently covered Mallinson's and Beltz's sections. The surface of the land has been denuded until all that remains covering the tin wash is some 10 feet of drift. The drift is composed of coarse to fine sea-sand, with horizontal layers of small well-rounded pebbles of quartz, quartzite, slate, and sandstone. The upper part under the grass roots is a ferruginous clay or sand, with a tendency to cementation. The stones in the wash include conglomerate, quartzite, sandstone, and slate, but no granite. These stones, therefore, cannot have been derived from

country lying to the south, but must have come from the north, and have been brought by the sea.

The wash averages 2 feet in thickness, though in places it exceeds this, and below it is a body of sand estimated to be 50 or 60 feet thick. The tin is brown to black in colour, and is in fine water-worn grains. It is associated with alluvial magnetite, and assays 73 per cent. No gold occurs with it beyond an odd colour or two. Mr. Beltz has worked the claim for the last five years. Last year the output was $6\frac{1}{2}$ tons.

The beds of wash are horizontal, which hardly accords with the idea of beach deposits, but may easily happen at some distance from the shore. The bedrock has only been reached in bores, and is said to be slate, which is probable, as granite is exposed further south. The tin-bearing deposit is evidently not a fresh-water lead, but most likely a marine terrace accompanied by spots suggestive of lagoons or marine backwaters, where quiet waters would deposit fine puggy sediments. This kind of sedimentation extended all over this great plain, and steady prospecting for the local concentrations, which obviously exist, will be good work.

(4) *Section 7169-m, 10 acres (P. G. Taylor).*—This is south-east of the preceding. Prospecting work has just been started. The sandy wash below the grass roots carries tin all through it, and if this proves payable, it will be of good augury for the success of search elsewhere on this plain.

South of Taylor's, on Crown land, is drift formerly worked by Chinamen, which also appears to be an old beach deposit with regular layers of wash, below which is soft sea-sand.

(5) *Section 1535-m, 20 acres (Black Duck).*—This is on a section in the slate and sandstone country, and situate between the Doone and the old Canary. The workings show 20 feet of pebbly drift which perhaps belongs to the modern river system. It is stated that men made wages here at one time, and ceased work only when the price of tin fell.

(7)—NORTH MT. CAMERON CLAIMS.

A string of old workings extends between the Mt. Cameron and Alhambra Creeks. The Chinese have been very persistent in working the ground here, some of which

is still yielding tin. These ancient sediments, which appear to be of the nature of beach gravels, form terraces more or less parallel with the mountain range, and have yielded no inconsiderable quantity of tin. Some of those which have been abandoned would be reworked if a constant water-supply were available.

Apart from the terraces, the various creeks flowing north from Mt. Cameron have brought down more or less tin, with the exception of Deep Creek. The latter stream has cut its channel down deep into the hard slate, which rises into steep high banks, and has probably scoured its bed clean of any tin deposits.

Sixtus Creek is the stream in which Mr. E. H. Wintle found the large crystal of topaz, which was sold in London for £60.

One and a half mile north-west from where the road crosses Sixtus Creek, and still north of the Ringarooma, is a 5-acre section (6832-M), in the name of J. C. Richardson. The workings are nearly on the level of the river, from which it is distant about $\frac{1}{4}$ -mile. The wash differs from that of many of the other mines, in that it appears to be of river origin. To the north-west, across a small creek, are some more workings, and it is desirable to ascertain whether they belong to the same channel of wash. A little to the south-east, across Gin Case Creek, is the old Native Lass Mine, comprising shallow workings on slate, some of them over 30 years old. The wash is a heavy mixture of stones of quartz, sandstone, and slate, sometimes with no drift between them. It is essentially a flat deposit of stones, nowhere more than 8 to 10 feet thick, and lying on slate exposed at surface in places. Although the Native Lass Company built the big dam to the south, it was never more than a winter claim. Some nice tin was got from it, but the ground is stated to have been poor.

(8)—SHALLAMAR FLATS.

These are on leases worked by F. W. and P. V. Cross on Vicary Creek, $2\frac{1}{2}$ miles south of the Ringarooma River, and 5 miles west of Gladstone. The flats are close under the northern face of Mt. Cameron, at the west end of the mount. They are outside the area represented on the Mt. Cameron mineral chart, but are dealt with here, as they were conveniently reached from Gladstone. The approach from Gladstone is by the Boobyalla-road as far as Rich-

ardson's dam-site, and thence by a bush road turning off west. Slate country continues until the Aberroe water-race is reached, when granite comes in at about $1\frac{1}{2}$ mile from the Shallamar Mine.

The Shallamar ground was worked many years ago, when good results were obtained from it. Since that time the output is said to have been indifferent, and the work, hampered by want of a regular supply of water, has been carried on only intermittently. The Messrs. Cross have worked it for years, but with storm water only, and are now making a beginning with steam plant. The flats have been bored from time to time by various people, none of whom, however, considered the deposit good enough for flotation. It is evidently patchy, but the owners have hopes, from what they have done on it, of making it a payable proposition.

The flat occupies a depression at the foot of the mount, deepening in the centre to between 30 and 35 feet, and shallowing again further north to 12 or 13 feet. The tin is stated to fall off going north.

The bed-rock of the various workings on the property is granite, but, singularly enough, the wash, which is about 2 feet thick, does not carry stones of granite. It consists of quartz and sandstone, with some stones of quartz-mica rock found in the lowest layer. The overlying drift 30 feet thick, also contains no granite stones. This is singular, considering that the rock-floor of the basin is granite and the high cliffs of Mt. Cameron are in close proximity. The quartz-mica stones in the wash may have been derived from the mount, but the sandstone in it, and the materials of the drift, must have been sea-borne. The tin was probably concentrated by marine action in different parts of the basin, and in such case continuous gutters of any length would not exist, but rather disconnected accumulations of ore in front of ancient sea-beaches.

The present owners appear to have made a good discovery, on which they are just starting.

V.—LODE AND STONE MINING IN THE GLADSTONE DISTRICT.

This comprises work on various tin and gold claims in different localities, viz. :—

1. Gold-mining at Gladstone; also wolfram.
2. Gold-mining in the Portland district.
3. Gold-mining in the Mussel Roe district.
4. Tin-mining on the Fly-by-Night and in Harden's Ravine.

(1)—GOLD-MINING AT GLADSTONE.

The history of gold-mining in the district at large goes back at least to 1870, when the Blue Bell reef was discovered. At that time excitement over the neighbouring Waterhouse goldfield led to prospecting in the Mussel Roe area. Several parties did a little work, and at the end of 1880 there was quite a rush to the Blue Bell, and adjoining sections. There was at that time considerable work in progress on auriferous reefs close to the township. In July, 1880, Mr. J. R. Chaffey secured ground along a reef afterwards known as the Royal Tasman, and reported as being from 4 to 6 feet wide, and highly auriferous. This started other claims, and very soon several parallel lines of reefs were located. One of these was the North Tasman line. Along the creek south of the Royal Tasman was the Deskford section, and still further south was the Lady Tasman. On the hill to the west of the creek, opposite the Royal Tasman, was the Royal Mint, floated in the beginning of 1881. North of it, on the same line, was the West Tasman, and south of it the South Royal Mint. Near the township the wide reef called the Royal Standard was taken up; north of it was the North Royal Standard, and south of it the South Royal Standard. South and adjoining the latter was the Golden Age, and further south the Midlothian.

In 1881 and 1882 work on both slopes falling to the Fly-by-Night was in full swing. The discovery of the Royal Tasman was responsible for the crop of subsidiary undertakings mentioned above, the life of which, however, did not greatly outlast that of the parent mine. The first battery to get to work was that of the Royal Tasman Com-

pany, which started a 15-head mill on the west side of the creek on the 29th August, 1881. The next battery erected was by the Royal Mint Company, which was started on the 24th October, 1881.

The extremely rich specimens and high assay returns obtained from the Royal Tasman originated the gold fever at Gladstone. A 10-lb. sample of picked stone treated at the Sandhurst School of Mines yielded at the rate of 146 oz. gold per ton, which, however, is not surprising, in view of the fact that a lump of gold, weighing over $\frac{1}{4}$ -oz. was found in the stone on breaking it down. A ton of quartz was crushed at Ballarat in November, 1880, and yielded a return of 20 oz. 9 dwt. 12 gr. smelted gold. This stone had just a trace of platinum, and $3\frac{1}{2}$ per cent. pyrites to the ton.

The second half-yearly meeting of the Royal Tasman Company was held in January, 1882, when it was stated that the first cleaning up at the mill took place on the 2nd October, 1881, and gave 467 $\frac{1}{2}$ oz. retorted gold from 322 tons of quartz. The second cleaning-up took place on the 4th November, and gave 611 oz. retorted gold from 595 tons of quartz. The last cleaning-up was not reported, but the shareholders were informed that it was less satisfactory than the previous ones, owing to a quantity of inferior stone having been put through the battery. The chairman said that the shoot of gold had run out, but better things were hoped for when information had been obtained how to save the gold contained in the pyrites, with which the stone was heavily charged. Some crushings in the early part of 1882 continued to give over 1 oz. gold per ton of quartz, but the returns gradually fell off till in April it was considered best to stop work and devote some attention to prospecting the property. At the half-yearly meeting in July, 1883, it was stated that it was useless to carry on the company, either as a gold mine, or in the hope of a payable tin lode being struck, and it was decided to wind it up as speedily as possible.

As the yields in the Royal Tasman declined, interest in the outside mines languished, and gradually for various reasons they suspended operations.

In 1909 gold-mining at Gladstone was revived by the Dreadnought Gold Mining Syndicate, on the reef descending from surface to the No. 2 Tasman tunnel, and by the Gladstone Gold Prospecting Association at O'Halloran's and Saville's discovery on the Royal Mint line.

Lately a fresh impetus has been given to lode-mining in the locality by Messrs. Fleming and O'Halloran, who have been working gold reefs on the old Royal Tasman section, and a wolfram lode, which crosses the Royal Standard reef at the back of the township.

(a)—*O'Halloran and Fleming's Gold and Wolfram Mines.*

Section 7151-m, 80 acres.—This section is situate on and at the back of the Gladstone township, crossing the Fly-by-Night Creek in one direction, and across the recreation reserve in the other. It embraces a large tract of slate reefing country, traversed by the principal gold-quartz lines of the locality, such as the Royal Tasman, North Tasman, Fleming's, Royal Mint, Royal Standard, and by Fleming's wolfram lode.

The gold-quartz reefs are a roughly parallel series coursing west of north and south of east. The wolfram lode, which is the only one of its kind known at Gladstone, crosses the direction of this series obliquely a few degrees north of east. There is some evidence to show that this wolfram lode, which also carries tin, is slightly older than the stanniferous gold-quartz reef known as the Royal Standard, for the latter has faulted the former a little in passing through it.

The wolfram lode and the Royal Standard, Royal Tasman, North Royal Tasman, and Fleming's reefs are between the township and the Fly-by-Night Creek. The Royal Mint and other reefs are on the opposite or west side of the creek. The work done on most of them in past days is evidenced by surface trenches or openings of the old shafts and tunnels.

Messrs. Fleming and O'Halloran have done some recent work on the North Royal Tasman reef, which used to be known as the Royal Tasman No. 2. Its long line is marked on the top of the hill overlooking the Fly-by-Night Creek by a series of shafts and surface excavations. An adit (the No. 2 tunnel) penetrates the hill at or nearly at creek level for a distance of about 300 feet in a direction N. 15° E., and reaches the reef at about 100 feet below the outcrop. Here it communicates with the old stopes. It has been turned round these stopes, and a few tons have been lately broken from the reef, which averages 5 or 6 feet in width. The reef bears north-west. Samples

taken from across the face of drive were assayed by Mr. W. D. Reid, Government Assayer, with the following result:—

Gold—9 dwt. 19 gr.

Silver—trace.

The stone is a white, rather hungry-looking, quartz, with occasional flakes of white mica on its faces. It tends to be vughy and greisenised, and now and then contains a little wolfram. The Royal Tasman reef ought to have been intersected in this adit, and its track is said to be visible in the walls, but no satisfactory evidence on this point was obtainable. A supposition which was popular at one time was that the reef which is worked further in is a faulted continuation of the Royal Tasman reef; but this is not probable.

The present owners have won a few tons of quartz, which has not been treated, but is stacked outside the mouth of the tunnel. There appears to be ample scope for driving on reef at tunnel level and opening up stopes.

About 170 feet south-east from the tunnel entrance the ruined stopes of the Royal Tasman Mine are visible along the flank of the hill for about 80 yards in length, bearing 335° . A short adit crosscut driven into the hill gave access to the workings at 60 or 70 feet above the creek; along this the stone was conveyed to surface and conveyed to the battery across the stream.

In the early work the width of the reef was reported as extremely variable, ranging from 2 to 6 feet in width. The high assay yields at the commencement of operations, and the eventually poor battery returns originated a suspicion that the mine was salted; but there is every reason to believe that this rumour was groundless. High assays of stone left on the dumps can be repeated at the present day. The falling-off in the returns appears to have been due to having to keep the battery supplied with stone, which could be done only by delivering quartz of inferior grade.

The reef courses along the side of the hill, and increased backs from the creek upwards cannot be obtained by adit-driving, consequently sinking would have to be resorted to for any future work. Going southwards it appears to pitch downwards, or else it terminates at the end of the stopes, for its outcrop cannot be traced further. At about 30 yards south-east from the stope end a new reef comes in, which has been opened on by Mr. Fleming. This runs,

roughly, parallel with the Royal Tasman reef, and the opinion has been expressed that it is either a fork or a faulted extension of that reef. Either of these suppositions may be correct, though judging from the general disposition of the several reefs in this belt of country, it is more probable that it is a new make. A shaft has been sunk on it recently to a depth of 23 feet. At the bottom of this the stone is 1 foot wide at the north-west end and 2 feet at the south-east end. Samples sent by Mr. Fleming from 10 feet down the shaft were assayed in the Geological Survey laboratory by Mr. W. D. Reid, Government Assayer, and yielded 8 oz. 1 dwt. 9 gr. gold, and 1 oz. 4 dwt. 7 gr. silver per ton. Another sample taken by Mr. M. J. Griffin, Inspector of Mines, returned 10 oz. 9 dwt. 2 gr. gold and 4 oz. 9 dwt. silver per ton. This was taken at 13 feet down the shaft. A further sample taken by Mr. Fleming assayed 4 oz. 1 dwt. gold, and 7 dwt. 20 gr. silver per ton. A sample taken by the writer from the present bottom of shaft yielded 15 dwt. 17 gr. gold and 2 dwt. silver per ton. These high assay returns are characteristic of the Royal Tasman reef series. The reef is practically vertical; if anything, it dips slightly into the hill. It has been trencched upon in two or three cuts for 60 feet north-west from the shaft. What is necessary now is to prove the length and downward persistence of the shoot.

It is proposed to drive an adit crosscut about 60 feet below the shaft collar, thereby obtaining 40 additional feet of backs. The reef, however, cannot be tested deeper than this without sinking. If the crosscut were prolonged, say, 50 feet beyond the shaft, it would set at rest the question of the extension of the Royal Tasman reef.

About 40 yards south-east from the shaft is the outcrop of a reef which acts probably as a crosscourse, and it will be of interest to ascertain how this affects the shaft reef. Some 75 feet south of it is an old shaft, on the tip of which is stone containing copper sulphide. Similar sulphide is present as minute grains in the quartz of Fleming's reef. All these reefs contain practically identical accessory minerals, viz., copper sulphide, arsenopyrite, mica, &c. It is said that this shaft was sunk 50 feet, and some quartz leaders driven on from it. If the shaft was sunk for the continuation of the Royal Tasman reef, it is a good way out of place, for that reef, if it continued, would pass a fair distance up the hill.

All over the hills through which the Fly-by-Night Creek flows are parallel reef lines, most of which have yielded gold, sometimes in rich shoots. In fact, the characteristics of the reefing belt may be summed up shortly, and in a general way, by saying that the occurrences comprise numerous shoots of gold-bearing stone, frequently with high values; but that, on the whole, the pay streaks are short. The shortness of the shoots may possibly be compensated for by their frequency. This implies the necessity for vigorous prospecting and development work. At present nothing is being done with the discoveries. A parcel of 5 tons has been sent forward for battery treatment, and a similar quantity is awaiting despatch; but funds are wanting for carrying out the further work which is necessary for establishing the value of the occurrences.

On the west side of the creek is the Royal Mint line of reef. It is difficult now to see what has been done on this line. A series of old shafts on a bearing north-west-south-east shows certain openings, which are presumably on the course of the reef, but beyond these nothing is visible. It appears that a main tunnel was driven for 220 feet, cutting the reef 4 feet wide and 60 feet below the surface. Some further work was done towards connecting the shafts by driving on the reef at this level. The stone in this drive was reported as averaging from 8 inches to 16 inches in width.

The Royal Mint Company was formed in 1881, with a capital of 20,000 shares of £1 each, issued as paid up to 10s. The reef at that time was described as being of a promising nature. Very substantial crushing machinery, with 15 heads of stamps, was erected. Means were devised for saving the tin from the tailings. From this it may be inferred that tin was found to be present in the stone. Local reports are to the effect that the reef had a decided tin content. Though a brave beginning was made, the enterprise was unsuccessful from the start.

Near the south-west corner-peg of Fleming's 80-acre section is O'Halloran's 40-foot shaft. No defined reef appears to have been struck, but Mr. Fleming states that an assay of some stone from the formation returned at the rate of 1 oz. 12 dwt. gold per ton. Another 40-foot shaft was sunk, and a drive put out in the direction of a gold-bearing vein seen at surface, but without success.

The whole of this hill could be prospected by a low adit, which would intersect the various reefs at depths

varying from 60 to 100 feet. The main tunnel driven by the Royal Mint Company could be utilised in such work. It is a low adit, driven into the hill for 220 feet, intersecting the reef-line under backs of 60 feet.

With gold-bearing reefs on the slopes of the hills on on both sides of the creek, it is singular that more gold has not been recovered from the creek bed. Mr. Gill states that he worked the Fly-by-Night Creek for six or seven years, and won about 20 oz. of gold from it. The heaviest piece was one of 3 dwt.

The Royal Standard is another of the reefs on which work was started in the latter end of 1880. Operations were suspended at the end of 1881 after a disappointing trial crushing. The North Royal Standard had stopped at the end of October.

The reef has a fine outcrop of massive quartz, and has been traced at the back of the township in a north-west-south-east direction for about 15 chains. Its surface width is from 10 to 15 feet, but at a depth of 50 feet it attained a maximum width of 22 feet. However, in the No. 2 shaft at the 100-feet level, the reef was reported as being broken up, and with a width only of 3 feet. Besides the two main shafts, a number of shallow pits and surface cuttings bear witness to the amount of prospecting done. Visible gold was reported in the stone, as well as tin oxide. Arsenical iron pyrites and copper sulphides are occasional accessory minerals. At the north end a shaft was sunk 60 feet, and the reef found to be 14 feet wide, containing a little fine gold associated with arseno-pyrites. In driving north the stone pitched underfoot, which accounts for the absence of surface indications in this direction.

The reef is evidently in the high temperature zone of mineral deposition, but does not appear to be payable, either for gold or tin.

Messrs. O'Halloran and Fleming have opened up a tin-wolfram lode, which crosses the Royal Standard reef at the back of the township. Its bearing is east-west, and its width from 9 inches to 1 foot. From adit workings last year nearly 4 cwt. of tin ore was obtained, assaying 73.5 per cent., and over 2 cwt. of wolfram ore, assaying 72 per cent. tungstic acid. The two metals keep for the most part in separate parts of the lode, the tin on the hanging-wall and the tin on the footwall. A low tunnel started by the North Royal Tasman Company above the Fly-by-Night Creek has been driven for about 800 feet,

cutting first the wolfram lode, and then the Royal Standard reef. The former is intersected a second time in driving south along the reef, which has displaced it southwards for a distance of 6 feet. The lode here is from 10 inches to 1 foot wide, and poor in wolfram.

Owing to the preparatory washing of the wolfram ore, no doubt a good deal of the mineral was lost. The lode, however, shares the characteristics of wolfram lodes generally in being patchy, the ore occurring in nests, with intervals of blank stone. It is likely to be persistent for a great length, and to preserve a more or less uniform size, apart from any local bulges which may occur. At present it cannot be said to be payable, but at any time patches may be met with which would put a better complexion on the undertaking. Its trend is under the school property and across the road, but its outcrop is hidden beneath surface accumulations. It is a unique reef for Gladstone, and its further development would be interesting, and might possibly prove profitable.

From the preceding remarks it will be gathered that this lease covers ground on which several reefs exist, and affords ample scope for prospecting. The Royal Tasman reef and Fleming's new make could very well be followed down below creek-level, and a moderate sum expended in exploratory work.

(b)—*Coarse Gold Creek.*

From time to time heavy gold has been recovered from this creek. At one place five quartz leaders have been uncovered in a distance of about 20 feet, and an assay of the stone in the Geological Survey laboratory returned at the rate of 9 dwt. 4 gr. gold and 1 dwt. 7 gr. silver per ton. Some work on this exposure is desirable; at present it is hardly possible to see how much stone exists.

About $1\frac{1}{2}$ chain north of the north-west corner of the Mt. Cameron water-race reserve, and to the east of Coarse Gold Creek, are some tin workings, in which a reef of white brittle quartz fully 2 feet wide has been exposed, bearing north-west-south-east. Assays ranging from 5 dwt. to 1 oz. gold per ton are said to have been obtained from the stone. On this visit a complete sampling was made of the reef for the whole length exposed, but the Government Assayer reports only a trace of gold. The stone is oxidised here and there, but no sulphidic mineral

is visible. It is exposed in the workings along a length of 76 feet.

(2)—PORTLAND MINE.

The Portland Gold Mine is situate about 4 miles north-east of Gladstone, south of Jno. Foster's Lot 966, 640 acres. It is approached by a bush road over level slate country, lightly timbered. The mine is on a large grassy or rush plain, with timber on the bounding banks. It is now abandoned.

The reef seems to have been found towards the end of 1880, for the press under the date of January, 1881, publishes a report from a Gladstone correspondent as follows:—

“Messrs. Moore and King, who discovered a new reef about 3 miles to the southward of the Blue Bell, have sunk about 13 feet on the lode, which is a foot wide, and carrying good gold, some excellent prospects having been obtained from the stone. This claim is called the Portland, and the holders intend to form a company and work it.”

The company was formed, and called the Portland Gold Mining Company. A main shaft was sunk 210 feet, and the lode cut at 80 feet, 150 feet, and 200 feet. Some stone was raised averaging about 2 oz. gold per ton, but as it could not be treated at the mine it had to be sent away, and the heavy cost of cartage, freight, and treatment left no profit, and work was suspended. In 1902 the mine was resuscitated under the title of the New Portland Gold Mining Company, and Mr. J. A. Windred was placed in charge. Mr. Windred has kindly supplied the following information:—

The lode down to No. 1 level carried a fair proportion of free gold, but was small, varying from 6 inches to a foot in width. Between this level and No. 2 it averaged 10 to 12 inches, and was plentifully charged with arsenical pyrites, accompanied by galena and zinc blende. There was very little free gold in this section of the lode, but the gold values were high, namely, from 1 to 3 oz. per ton. At No. 2 level, and below it, values were poor and patchy. An intermediate level between Nos. 2 and 3 levels still showed the presence of arsenical pyrites, and the ore looked as well as at the higher levels, but the values were not there. The width averaged about a foot. At No. 3 level the lode was 6 inches wide where struck,

nearly all quartz, worth 4 dwt. to the ton. It was driven on for 40 feet, being about a foot wide on the average, and consisting of low-grade stone. This was very disappointing, and had a good deal to do with closing the mine down.

Some good ore was sent to Sydney from between Nos. 1 and 2 levels. In 1902 samples were taken from the stopes and end at the 80-feet level, and the results of assays as published at the time were as follows:—

From the east stope—

Gold, 1 oz. 9 dwt. 9 gr.; silver, 2 oz. 11 dwt. 12 gr.

From the stope going west—

Gold, 2 oz. 5 dwt.; silver, 4 oz.

From the west end—

No. 1—Gold, 2 oz. 9 dwt.; silver, 7 oz.

No. 2—Gold, 3 oz.; silver, 7 oz.

No. 3—Gold, 1 oz. 5 dwt.; silver, 3 oz. 15 dwt.

No. 4—Gold, 1 oz. 12 dwt. 6 grains; silver, 4 oz. 4 dwt.

No. 5—Gold, 19 dwt. 14 gr.; silver, 3 oz. 18 dwt.

No. 6—Gold, 3 oz. 11 dwt. 2 gr.; silver, 16 oz. 0 dwt. 3 gr.

No. 7—Gold, 1 oz. 6 dwt. 3 gr.; silver, 2 oz. 9 dwt.

No. 8—Gold, 2 oz. 11 dwt.; silver, 8 oz. 10 dwt.

No. 9—Gold, 1 oz. 15 dwt. 3 gr.; silver, 4 oz. 8 dwt.

No. 10—Gold, 2 oz.; silver, 5 oz. 14 dwt.

Samples of some of the old stone taken on the present journey were assayed by the Government Assayer and yielded at the rate of—gold, 2 oz. 4 dwt. 10 gr. per ton, and silver, 5 oz. 12 dwt. 9 gr. per ton.

The reef at surface bears about 320° . About 50 feet north of the shaft is a small pit full of water, and about 50 feet west of shaft, and 40 feet north, is a small shaft, probably on a second lode or branch.

The Portland stone is a hard grey quartz, charged, in the order of their abundance, with arsenopyrite, galena, and zinc blende, and would appear to belong to the type of arsenopyritic gold quartz veins. A noticeable character is the high proportion of silver to that of gold. In gold quartz reefs of this age the gold usually preponderates, but the Portland ore differs in this respect, the silver exceeding the gold content two or three fold. It is a feature which in Tasmania generally betokens the close proximity of granite.

Seeing that there is so little free gold in the upper part of the lode it is singular that the gold content should fall off so rapidly in descending, and there is reason for believing that this is a primary and temporary change. A rather serious feature, however, is the small size of the lode, and this may be expected to persist. Sooner or later the values will probably recur, but the mine in its present state can only be described as a prospecting show.

(3)—GOLD MINES WEST OF THE GREAT MUSSEL ROE.

In slate country north-east of Gladstone a group of gold-quartz reefs occur, in which free gold is met with in the shallow zone, associated with other minerals, such as arsenopyrite, galena, and blende. What deeper work has been done on the reefs has tended to show an increase in the proportion of accompanying minerals, and to support the expectation that in depth the gold will be found exclusively locked up in the sulphides.

From time to time a little work has been started on these reefs on the strength of encouraging assays from the superficial zone, but investors were invariably discouraged when the sulphides began to predominate. At the same time, at one mine at least the sulphidic minerals appear to be rich in the precious metals.

These reefs occur in the country which lies west of the Great Mussel Roe River, and attracted attention a good many years ago. The Blue Bell reef was discovered in 1870, when the excitement over the Waterhouse goldfield led to prospecting in this district, and since then several parties have carried out some work on it. In 1880 prospectors obtained promising indications close to the old mine, and a rush set in. At the end of that year ground was taken up on the Mussel Roe field in all directions. Further north Gilham and party operated on a large reef, also McLean and Moore and party worked reefs. At the beginning of 1881 McLean and party took over the old Blue Bell, with the intention of putting up machinery and working the claim as a private company. About the same time Moore and King discovered the Portland reef, and obtained excellent prospects from the stone.

Some trial crushings from the Mussel Roe reefs gave at that time a return of 1 oz. 5 dwt. and 10 dwt. gold per ton. Shafts were sunk to the depth of 100 feet, a low-head battery erected, and on a couple of the claims work

was prosecuted with energy, but on a majority of the holdings very little work was done, the leases being held, apparently, for speculative purposes. Mr. Thureau, the Government Geologist, who visited the field in 1881, was of opinion that the output of the field generally would be from an assemblage of small veins and leaders, and that an amalgamation of the claims was desirable in order that a central crushing plant might be used, instead of individual proprietaries going to the expense of crushing small quantities of quartz from their respective properties.

On the present journey some of these reefs were pointed out by Mr. J. Groves and Mr. Ross, mostly situate on the 1000-acre grazing lease of J. Groves, No. 629. The greater part of the lease is occupied by slate and sandstone of Cambro-Ordovician or Ordovician age, but the northern part consists of granite. The auriferous quartz veins are in sandstone and slate. They have a strong family resemblance to one another, being charged with gold-bearing sulphides. The largest reef is that known as the Big Mussel Roe reef, which comprises 80 feet of formation material, as exposed in the river bank, but perhaps about 50 feet solid. A good deal of country is mixed with it, and quartz and country would have to be taken out together. This reef will probably be found to be not actually so wide as it seems, for it appears to impinge on the river at a long angle, which exposes a wider section than would be given by a right-angle traverse. Consequently, it is not surprising to hear that it has not been picked up on the opposite bank of the stream. The bearing, so far as can be observed, is north-south. The stone is heavily charged in places with pyrite and arsenopyrite, accompanied by galena. Samples taken on this occasion were reported by the Government Assayer (Mr. W. D. Reid) as returning—gold, 2 dwt.; silver, 2 dwt. 15 gr.—per ton. A little north from here is a formation of quartz veins traversing indurated sandstone in a north and south direction. The quartz is hard and glassy-looking, and charged with arsenopyrite, and its green decomposition product, scorodite. The assay of samples in the Geological Survey Laboratory yielded 3 dwt. 6 gr. gold and 4 dwt. 14 gr. silver per ton. Further north, on the top of the next hill, is an old shaft sunk on a few inches of quartz, from which samples yielded only a trace of gold. Just above the falls on the river, and on the east side of it, is Ross' reef. The stone shows no visible gold, and there was only a trace of gold on assay.

This Mussel Roe group of veins comprises a series rather poor in gold. The only reef which seems worth some attention is the Big Reef, at the river; but here work below river-level is certain to be attended with trouble from water. An increase of sulphides may be also anticipated in depth.

About a mile west of the river is the Blue Bell and Prince Imperial group of reefs, which appear to be a parallel series. The Blue Bell Mine had been abandoned for a long time. The Prince Imperial was taken up again in 1907. The old shaft had been sunk on stone, which at a depth of 20 feet split up into auriferous veins heavily mineralised with arsenopyrite, with some galena. These were gold-bearing, and the hard sandstone between the veins was also mineralised. The shaft was sunk 5 or 6 feet further with the same results. A new prospecting shaft was sunk 26 feet close to the old one, and the reef in the bottom was examined by the writer in 1907. The floor of the shaft was found to be occupied by a formation of metamorphic sandstone veined with quartz, and about $3\frac{1}{2}$ feet wide. On its west side a cuddy exposed 4 feet of slate and sandstone, and then 18 inches of quartz and 6 inches of pyritic matter. Samples from the floor of the shaft returned on assay 8 grains of gold per ton (comparatively little pyrite was present in this sample); from the cuddy, 13 dwt. of gold and 7 dwt. of silver per ton. The promoters had a cwt. of stone taken from the surface and from across the reef in the course of sinking, and this was tested at the Ballarat School of Mines. Some higher results have been obtained from different parts of the reef. The features of the occurrence stamp it as belonging to the group of the arsenical gold-quartz veins, which in Tasmania are frequently found near granite masses. A little further work was done on this reef subsequently, but without satisfactory results, the stone becoming very pyritic. The writer recommended in 1907 that the reef be prospected first by exposing it for some distance on its course by deep trenching, and then, if it is found to be continuous, a shaft can be sunk with some confidence that the stone will be fairly permanent. This would enable the reef to be explored on its course underground, with a view of proving payable shoots.

Inside the northern boundary of John Foster's Lot 833, 640 acres, a body of indurated sandstone veined with quartz crosses the Cape-road. The occurrence has the aspect of an irregular silicification of the sandstone, but

possesses no economic value, for samples taken assayed only 1 dwt. 7 gr. gold and 16 gr. silver per ton.

(4)—THE TIN MINES NEAR GLADSTONE.

(a)—*Fly-by-Night.*

Section 1098-M, 20 acres (owned by F. Whitaker and A. Daw).—This is about $\frac{3}{4}$ -mile south-east of Gladstone, on ground falling to the Fly-by-Night Creek.

The junction of granite with slate occurs in the western part of the section, and is responsible for an extensive deposition of tin ore within the boundary of the granite. For a width of about 10 chains the marginal part of the granite has been altered to a rock consisting practically of quartz and a silvery mica, for which the name greisen is the most appropriate. This belt of greisenised granite is intersected by a network of tin-bearing veins, some almost as thin as a sheet of paper, others feet wide. Assemblages of these veins constitute a formation, and such formations run both parallel with and at right angles to one another. Some of the joints in the altered granite are filled with softened mica only, and these are often extremely rich in tin. Rich nests of tin oxide are often met with. For instance, from one little hole in soft formation, about 3 feet square, $2\frac{1}{2}$ cwt. tin ore were obtained. From another a hundredweight was won in a couple of hours.

This tin-bearing belt or stockwork goes right through the property, and has been exposed by stripping from one end to the other.

Sluicing was carried on nearly 40 years ago, and some of the old ground would probably pay to work over again. After rain tin can be readily seen in the old worked ground. It is stated that in the old days a working party of six men won 40 tons of ore in a single winter season.

The ground for the most part is such as can be worked with the pick or with little explosives, being softened granite: this has been channelled in the main workings to a depth of from 6 to 10 feet. The present owners are crushing stone by means of a primitive spring-pole stamp. The tin ore produced is clean and free from accessory minerals. It assays from 73 to 74.5 per cent. tin.

It seems strange that ere this outside capital has not been brought in to develop the property. This is probably due to the fact that no deep work has been done, and perhaps to a pessimistic fear lest the tin should prove to be only

a shallow deposit. But even without underground mining, the natural fall of the surface is sufficient to show that tin is present in the bedrock at horizons differing from one another by a vertical distance of at least 70 or 80 feet. This depth, consequently, is established without the aid of shafts or bores.

It may be taken that the zone nearest to the slate contact will be the richest, and that eventually, as the slate is left behind, the stone will become poorer.

From the experience gained in actual working, the owners feel confident that the whole formation will bulk over 1 per cent. tin oxide, and there certainly does seem enough stone exposed to warrant the erection of a small battery to treat it. For work on a larger scale, however, it would seem desirable to first test and sample the whole ground systematically, so as to ascertain its actual value as a quarrying proposition. For work on any important scale water would have to be pumped from the Ringarooma upwards of 200 feet.

Judging from present appearances, expenditure on this property would appear to involve much less than the usual mining risks.

(b)—*Harden's Ravine.*

This valley, south of the Empress Range, is excavated in the zone of greisenised granite which borders the slate boundary-line extending from the Fly-by-Night. Large surfaces of bedrock exposed by extensive sluicing operations slope down westwards to the Ringarooma, and the granite crosses the river a few hundred feet north of the Esk Dam. Much of the rock is a good deal harder than that on the Fly-by-Night, and some of it passes into a fine-grained granite. Although it has been the seat of considerable tin deposition, and parts of the area might conceivably prove to be payable, the immediate indications are, on the whole, not at all decisive. Very good facilities, however, exist for proving some of the ground in depth by tunnelling. A beginning has been made in this direction, but the risks of such work properly belong to associations with substantial means to back their venture.

(c)—*Murray's Section, 5793-M, 5 acres.*

This is a section (now vacant) in the timber up the hill east of the new bridge over the Ringarooma, on the Cape Road. A little work has been done on a greisen dyke or

lode in slate country and about a chain or so from the granite. The lode strikes 330 degrees, and is about a foot in width. The work consists of an open drive 37 feet long, and another drive 18 feet long, with a shaft between the two drives. The stone on the tip is full of coarse tin ore, but the faces at both ends of the drives are poor.

The first work which should be done here is to follow the lode southwards into the granite, in the hope that some improvement may take place, and then to follow the tin down where it was met with in the drive. The deposit may be unimportant, or it is quite possible that it may be payable either in the granite or at a greater depth in the slate. The indications are hardly good enough to warrant testing it by a long adit from the road, but the fact that tin is present is warrant enough for not neglecting the occurrence altogether.

VI.—GEM STONES.

Topaz.—Mt. Cameron has long enjoyed a reputation for its topaz crystals. Sixtus or Wintle's Creek is celebrated for Mr. Wintle's discovery of an exceptionally fine specimen, which was sold in London for £60. This was a large crystal of good quality. The late Mr. W. F. Petterd also had a crystal of topaz from Mt. Cameron, 8 inches in length, which is an unusual size for the locality, but insignificant in comparison with the large Norwegian topaz in the British Museum, which is 2 feet in length, and weighs 137 lb.

The stones at Mt. Cameron are found in the creeks and tin drifts, but have evidently been derived from veins in the granite rock. They are generally well rounded and worn by water, and as a rule they show fractures caused by being knocked about in the drifts. Colourless stones are met with, but are rarely what can be called water-clear, having a slight cloudiness. The usual tint is a very faint bluish or sometimes greenish tinge. The cloudy variety is known to jewellers by the name of common topaz, and has no practical value as a gem: but the water-clear variety is what is called the gem topaz. The latter is found on Flinders Island, and its lustre, if the stone has been well-cut and polished, is not far short of that of the diamond. In fact, stones have sometimes been sold as diamonds. The topaz has the same specific gravity as the diamond, but it is doubly refracting and not so hard. It is, however, heavier than quartz, and crystallises in a different system (orthorhombic). It is rare that one finds at Mt. Cameron stones which are of greater value than the cost of cutting them would be, and there is practically no market for the generality of stones found. The present price for cutting the stones is from 1s. to 1s. 3d. per carat, according to size.

Sapphires.—The Gladstone drifts contain sapphires now and then of various shades of blue, but scarcely ever the tint of the royal cornflower blue, which is so greatly prized by connoisseurs.

The hardness of sapphire being so great, a trial was made in 1883 with the Government diamond-drill, using sapphires in lieu of diamonds. In ten minutes, with only 10 lb. of air-pressure per square inch, most of the stones were gone and the rest fractured. Corundum, from Lisle, was tried, with still more disastrous results. The Flinders Island topazes were found to be so liable to splinter that it was only loss of time attempting to set them.

Smoky Quartz.—Crystals of this variety of quartz are very characteristic of the drifts from the northern slopes of Mt. Cameron, and on this account their presence in the tin wash in any quantity is very helpful in establishing the source of the gravel deposits. The tints range through faint yellow, brown to black. Some of them have the tint of the Scottish cairngorm. The various colours of this variety of quartz have been ascribed to ferric oxide, but with more probability to volatile compounds of hydrogen and nitrogen, which have been distilled in the laboratory in liquid form.

The Chinese workers collect the best stones and send them to China for making lenses, crystal spheres, cutting up for articles of adornment, &c. In some parts of the world these crystals are found of large size, up to 3 feet in length, and in nests of tons weight. When they possess the true brown cairngorm tint, they are of great beauty and are worth cutting and mounting as gems. Most of those met with at Mt. Cameron, however, are coarse and valueless.

VII.—AUSTRALITES OR OBSIDIANITES.

A few of these interesting objects have been met with in the district. The late Mr. Thompsitt had some fifteen or sixteen of them which he found in the Amber Creek: and another has been found in a creek flowing from the south slope of Mt. Cameron. Mr. A. Mallinson came across one while working his ground on Section 5359 on a false bottom 7 or 8 feet from the surface. The latter must be rather older than has been the case generally with Australites found in Tasmania, as it clearly dates from a time when the land configuration was very different from what it is now. The composition of Australites appears to differ materially from that of any normal igneous rock hitherto met with in the crust of the earth, and their derivation from neighbouring volcanic masses of identical age is out of the question. Their occurrence independent of, and unrelated to, the geological age or the nature of the surrounding rocks, points to a source outside the areas in which they are discovered. The extra-terrestrial hypothesis of origin, which regards them essentially as glassy meteorites, is the one which receives most support from the facts as at present known. Some foreign geologists seem inclined to consider them as artificial products, but this is only an instance of how difficult it is for observers at a distance to appreciate the conditions under which these mysterious objects are found.

VIII.—DISCOVERY OF CHIPPED ABORIGINAL FLAKE AT THE DOONE MINE.

During the present journey a small chipped flake was found at the Doone Mine by one of the lessees, Mr. Richards, and was presented by him to the Department for placing in the survey collection at the Victoria Museum, Launceston.

It is a small flint-like stone of chalcedony, chipped to shape and then to a serrated edge. It is about an inch square, but not quite complete, as a part of it broke off in picking it out of the matrix. It was found firmly adherent to the top of the bed of tin wash which is being broken down with the nozzle at this mine, and it was *in situ* at 10 feet from the surface. The 10 feet of marine drift which covers the wash represents a remnant of a much thicker bed of marine deposit which marks a former advance of the sea to the northern flank of Mt. Cameron. The wash, and consequently this implement, antedate the deposition of the oldest layers of the marine drift. It antedates also the formation of the present channel of the Ringarooma, and is the oldest aboriginal product of which any record exists in Tasmania.

IX.—CONCLUSION.

The Gladstone district figures as an ore-producer from the very earliest days of tin-mining in the island, and its output has continued from that date to the present without interruption. It is in the nature of an alluvial field for its production to decrease as its stores of mineral are gradually removed, until finally practical depletion ensues. In the early days, when the alluvial ground here was first attacked of course the output was necessarily in advance of what it is to-day, but for a long time now it has settled down to a more or less uniform rate, and the modest tonnage which is regularly recovered serves to support the community without undergoing the sometimes disastrous fluctuations which are felt in other fields. The profitable nature of the industry depends greatly on the ruling market prices of tin.

It will be gathered from the preceding pages that there is no reason for believing that the deposits are exhausted, or that they will be exhausted in the immediate future. In many cases deposits which have been abandoned in past times as no longer remunerative, perhaps owing to the then low price of tin, have been worked again with satisfactory results. Seeing that it is probable that the ore over large areas has been derived, not from any particular reef or lode formation, but rather from the slow wearing down of the granite bedrock, there are good grounds for supposing that deposits of tin are also widely distributed, and it is this fact which inspires strong hopes for the continuance of mining in this field for a good time to come. The wide distribution, however, necessitates continuous prospecting, with the view of locating the various ore-concentrations. It cannot be expected, especially under present circumstances, that working parties can afford much time or money in this class of work, however indispensable it may be, and it is in order to cope with this difficulty that the Mines Department, per the medium of the Mt. Cameron Water-race Board, is coming to the assistance of the inhabitants by providing facilities for exploratory boring.

The observations made by the writer on the present journey have led up to the conviction that the drifts of the Great Northern Plain, of the Edina country, and the Amber Creek region conceal deposits of tin which may never be disclosed in default of drilling on an extensive scale. The belt of greisenised granite which extends from the Fly-

by-Night to Harden's Ravine is a certain repository of tin ore, and at the Fly-by-Night end is being worked on a limited scale with good results. The stone there promises to be ample enough in its extent and good enough in quality for the inauguration of work on a larger scale. The Harden's Ravine end has not been sufficiently tested to enable anything definite to be predicted; the stone there is harder and more siliceous, and not quite so favourable, but geologically it is promising enough. There are also a few greisen dykes near the township, some of which have yielded tin, but from their size they are not likely to add appreciably to the general output.

The tin-wolfram lode on O'Halloran and Fleming's section is a quite exceptional occurrence for Gladstone, and has returned a small parcel of mineral. The patch which has been worked has apparently gone out for the time, after the manner of wolfram lodes, but the lode itself, though narrow, is very persistent. Blanks in it are likely to prevail for indefinite intervals.

The revival of gold quartz mining has been due to the exertions of Messrs. Fleming and O'Halloran, who have prospected the reefs on the old Royal Tasman and Royal Mint hills. A gold-bearing reef has been located above the Fly-by-Night Creek, a member of the Royal Tasman series, and development work is proceeding. No deep work was ever undertaken on the Royal Tasman reef itself, and the present attempt to prove an undoubted shoot of gold is perfectly legitimate in its character, and it will be watched with interest. The conclusion reached by the writer in respect of the sets of parallel reefs of these hills is that exploration is likely to reveal rich shoots, but discontinuous; the frequency of the shoots, however, may compensate for their shortness.

An unusual feature, but one of great interest to the student of ore deposits, is the frequent association of gold and tin in some of these reefs. They are evidently in the zone of the high temperature tin deposits, and cannot be correlated with the gold reefs of, say, Mathinna or Mt. Victoria. It is probable that the closer the reefs approach the border of the adjacent granite the more will the tin content predominate.

A few miles from the mouth of the Mussel Roë River the granite rock comes again to the surface, and shows a tendency to the development of wolfram in small quantities. The ground here and to the east right away to sea has been

very imperfectly prospected, and it is difficult to get any satisfactory information about it. It has no doubt been overrun by prospectors at one time or another, but evidently nothing of value was found.

Between these two exposures of granite is the Mussel Roe slate country, which is traversed by several gold-bearing quartz lodes, charged with arsenical pyrites and sometimes with galena and zinc blende. The Mussel Roe reefs, the Bluebell, the Prince Imperial, and the Portland are reefs belonging to this type. Some of them in certain parts have shown good gold contents, but have a tendency to become more pyritic with continued work, and at no great depth to pass from the richer upper zone into the poorer zone of primary ore. The Portland reef, which gave very good results at a little depth from the surface, where it was, although narrow, strong and encouraging, fell off in quality considerably at 200 feet down, and at present all that can be said of it is that it invites exploration.

The foregoing represents concisely the present outlook for mining in the district. In a word, there is some hope that the gold mining at the Gladstone township may continue on a moderate scale, but the backbone of the field is, and will be, its tin-mining, to which both alluvial and stock-work mines will contribute. The streams of the region have selected their channels without any consideration for mining claims. Many of the sections can only be worked in the winter season by storm waters; others are remote from creeks, and some suffer from being too high. In this connection, one cannot but recognise the immense benefits conferred by the Government race, which, with its branches, ramifies through the district from the upper Great Musse Roe to the Aberfoyle, within a few miles of the sea. The manager of the race, Mr. H. Harvey, resides at Gladstone, and the Board which administers it under the Mt. Cameron Water-race Act also holds its meetings there. A representative of the local miners has a seat on the Board, and the claims of the district and section-holders always receive the serious consideration to which they are entitled, both in their own interests and those of the district in general. It is an example of a well-managed Government-owned undertaking, and has splendidly accomplished its task these many years of fostering and assisting the industry and keeping this remote community together.

The writer desires to acknowledge assistance and information received from Messrs. H. Harvey, Curnow, Fleming,

O'Halloran, Beltz, Barnes, Murray, Richards, Richardson, Galloway, Groves, Daw, Whitaker, and other residents of the field, as well as from Mr. C. C. Ryan, who kindly communicated his results of boring at the Scotia

W. H. TWELVETREES, Government Geologist.

Launceston, 28th August 1916

GEOLOGICAL SURVEY OF TASMANIA.

LIST OF PUBLICATIONS.

BULLETINS.

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| No. 1.—The Mangana Goldfield, by W. H. Twelvvetrees | 1907 |
| No. 2.—The Mathinna Goldfield, Part III., by W. H. Twelvvetrees | 1907 |
| No. 3.—The Mt. Farrell Mining Field, by L. Keith Ward, B.A., B.E. | 1908 |
| No. 4.—The Lisle Goldfield, by W. H. Twelvvetrees | 1908 |
| No. 5.—Gunn's Plains, Alma, and other Mining Fields, North-West Coast, by W. H. Twelvvetrees | 1909 |
| No. 6.—The Tinfeld of North Dundas, by L. Keith Ward, B.A., B.E. | 1909 |
| No. 7.—Geological Examination of the Zeehan Field, Preliminary Statement, by W. H. Twelvvetrees and L. Keith Ward, B.A., B.E. | 1909 |
| No. 8.—The Ore-bodies of the Zeehan Field, by W. H. Twelvvetrees and L. Keith Ward, B.A., B.E. | 1910 |
| No. 9.—The Scamander Mineral District, by W. H. Twelvvetrees | 1911 |
| No. 10.—The Mt. Balfour Mining Field, by L. Keith Ward, B.A., B.E. | 1911 |
| No. 11.—The Tasmanite Shale Fields of the Mersey District, by W. H. Twelvvetrees..... | 1911 |
| No. 12.—The X River Tinfeld, by L. Keith Ward, B.A., B.E. | 1911 |
| No. 13.—The Preolenna Coalfield and the Geology of the Wynyard District, by Loftus Hills, M.Sc. | 1913 |
| No. 14.—The Middlesex and Mt. Claude Mining Field, by W. H. Twelvvetrees | 1913 |

No. 15.—The Stanley River Tinfeld, by L. Lawry Waterhouse, B.E.	1914
No. 16.—The Jukes-Darwin Mining Field, by Loftus Hills, M.Sc.	1914
No. 17.—The Bald Hill Osmiridium Field, by W. H. Twelvetrees	1914
No. 18.—Geological Reconnaissance of the Country between Cape Sorell and Point Hibbs, by Loftus Hills, M.Sc.	1914
No. 19.—The Zinc-Lead Sulphide Deposits of the Read-Rosebery District, Part I. (Mount Read Group), by Loftus Hills, M.Sc. ...	1914
No. 20.—The Catamaran and Strathblane Coal-fields and Coal and Limestone at Ida Bay, Southern Tasmania, by W. H. Twelvetrees	1915
No. 21.—The South Heemskirk Tinfeld, by L. Lawry Waterhouse, B.E.	1915
No. 22.—Catalogue of Publications issued by the Government of Tasmania, relating to the Mines, Minerals, and Geology of the State, to 31st December, 1914, compiled by W. H. Twelvetrees	1915
No. 23.—The Zinc-lead Sulphide Deposits of the Read-Rosebery District, Part II. (Rosebery Group), by Loftus Hills, M.Sc. ...	1915
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No. 1.—Preliminary Geological Report upon the Mt. Balfour Mining Field, by L. Keith Ward, B.A., B.E.	1910
No. 2.—The Silver-lead Lodes of the Waratah District, by L. Keith Ward, B.A., B.E.	1911
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- No. 4.—On Cement Materials at West Arm, by W. H. Twelvetrees 1914
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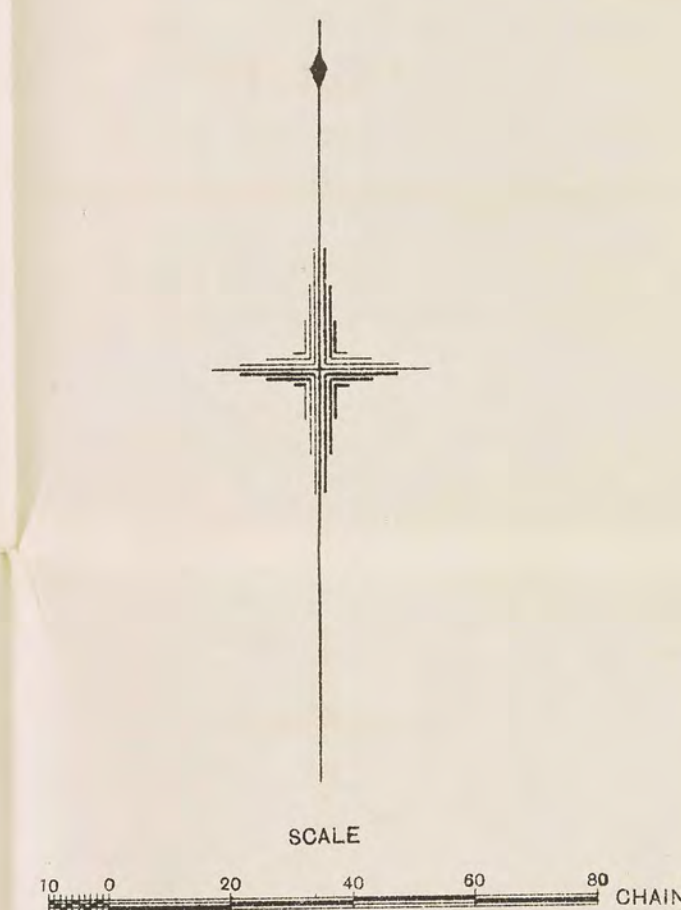
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- No. 2.—Stichtite: A New Tasmanian Mineral: Notes by various authors, collected and edited by W. H. Twelvetrees 1914
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
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- Part II.: Middlesex and Mt. Claude Districts, by Loftus Hills, M.Sc. 1916
- Part III.: King Island, by L. Lawry Waterhouse, B.E. 1916

GEOLOGICAL SKETCH MAP OF THE GLADSTONE DISTRICT



LEGEND

PRE-SILURIAN _____ *Slate & Sandstone* _____ 

DEVONIAN _____ *Granite* _____ 

KEY TO NUMBERS OF MINERAL SECTIONS

Number of Section	Acres	Lessee
6295-M	240	James Galloway
4122-M	40	"
9191-33M	20	"
1732-33M	20	"
5084-M	20	H. Ware
5193-M	5	"
5827-M	5	"
6621-M	10	"
6534-M	10	"
6282-M	10	"
6635-M	10	"
6524-M	5	"
1745-M	10	Aberree Tin & C. N.L.
3764-M	10	"
5560-M	20	"
4594-M	5	"
6950-M	5	"
6961-M	5	"
7141-M	5	Richards & Murray
7037-M	10	"
7029-M	5	"
7036-M	5	"
7185-M	10	P. G. Taylor
6852-M	5	J. C. Richardson
6520-M	20	B. S. & A. H. Hallinson
7081-M	10	M. J. Groves
7084-M	5	"
7087-M	5	"
7066-M	10	"
7061-M	5	"
6987-M	5	"
6731-M	5	Rankin & Ogilvie
1008-M	5	"
7423-M	20	J. Fleming
221-33M	20	Horn Walk Chung
3944-M	5	Joe Oen
7414-M	5	F. Whitaker
5892-M	5	E. H. Gill
7102-M	5	"
7191-M	5	O'Halloran & Fleming
7334-M	10	B. S. & A. H. Hallinson
7107-M	5	M. J. Groves
7090-M	10	"
7407-M	5	"
7363-M	2	Richards & Murray

W. H. Twelvetrees,
Government Geologist.
26. 8. 16

Government Bore
No. 1 Line

No. 1 Line
Photo Algraphed by John Vail Government Printer Hobart Tasmania.



